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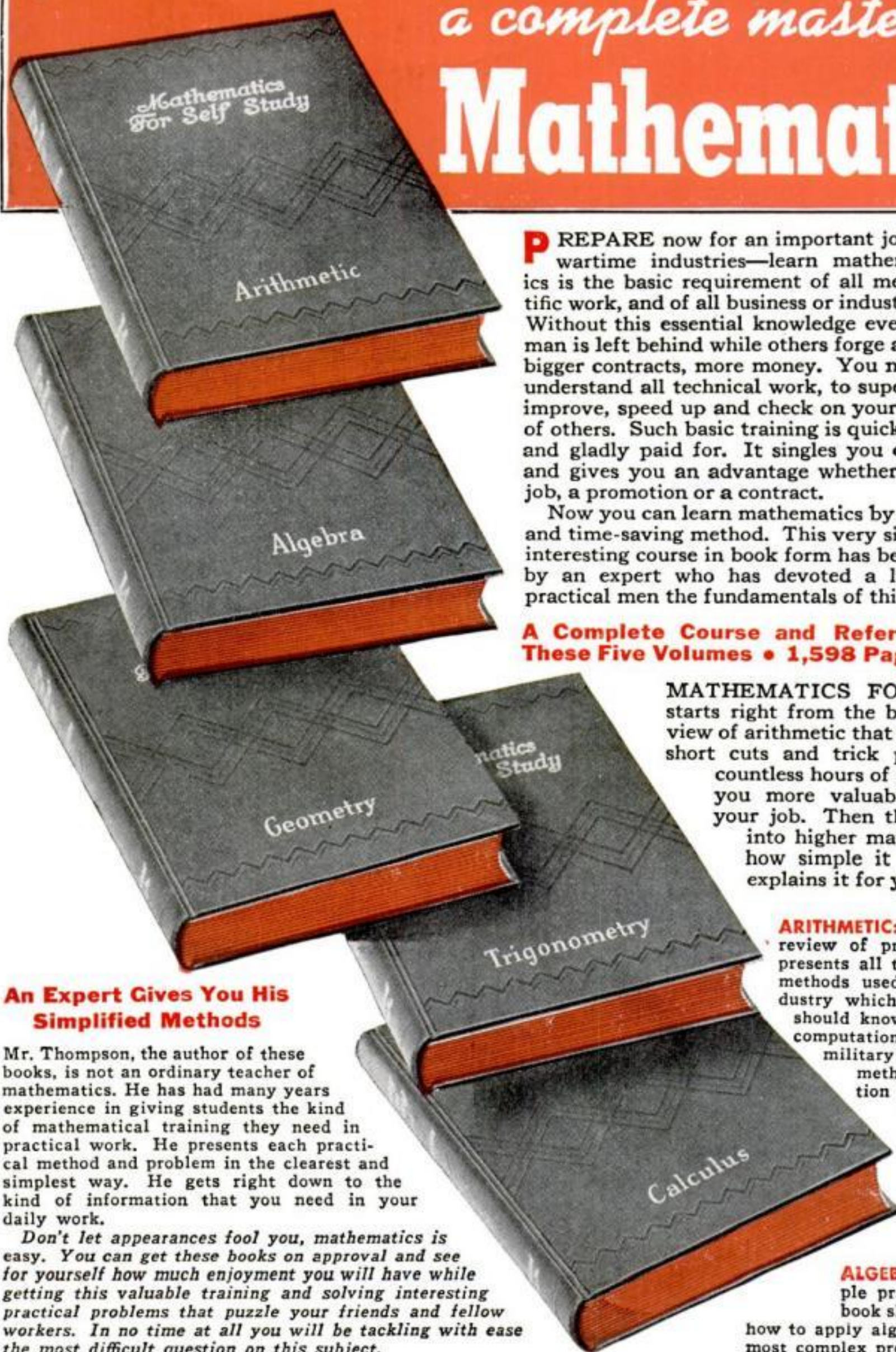
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CONTENTS for MARCH, 1942

News

Fighting the Submarine Menace.....	49
\$2,500,000 Worth of Planes a Day.....	52
Gasoline for the Army.....	62
Tether Flying.....	69
Home Workshops Go to War.....	73
Before the Bomber—Observation.....	82
Strikes and Spares.....	90
Now They Do It with Rubber.....	97
Short-Order Airports.....	101
Blackout.....	115
Magnesium from the Sea.....	122
Finding the First American.....	125

Automobiles

150,000 Miles from Your Car.....	129
Adjustments for a Wartime Fuel.....	135
New Life for Old Engines.....	138
Gus Wilson's Model Garage.....	142

Home and Workshop

Repairing Exterior House Walls.....	146
Make Your Own Fishing Flies.....	156
Durable Plywood Tool Cabinet.....	170
Typewriter Desk for Home Use.....	180
Building Model Planes from Kits.....	192
Cash Prizes for Tin-Can Projects.....	195
Science Stunts with Electricity.....	198
Two-Way Radio Station Costs \$18.....	200
Synchronized Sunlight for Photos.....	206

Departments

Our Readers Say—.....	14
Un-Natural History.....	109
Here's My Story.....	112
Radio Department.....	200
With the Inventors.....	232

(Contents continued on page 4)



Our
Cover

IN THE cover painting by Matt Murphey, U.S.N., the U.S.S. Boxwood, anti-submarine net layer and tender, is lowering an anchor to secure a harbor-defense net to the sea floor. She flies the red "powder flag" indicating that she carries dangerous materials, and the two black balls at her yardarm warn other vessels that because of the work she is doing she cannot observe regular ocean traffic rules. The signal flags make up the recognition signal of a passing vessel, with which the signalman above the bridge is communicating by blinker.

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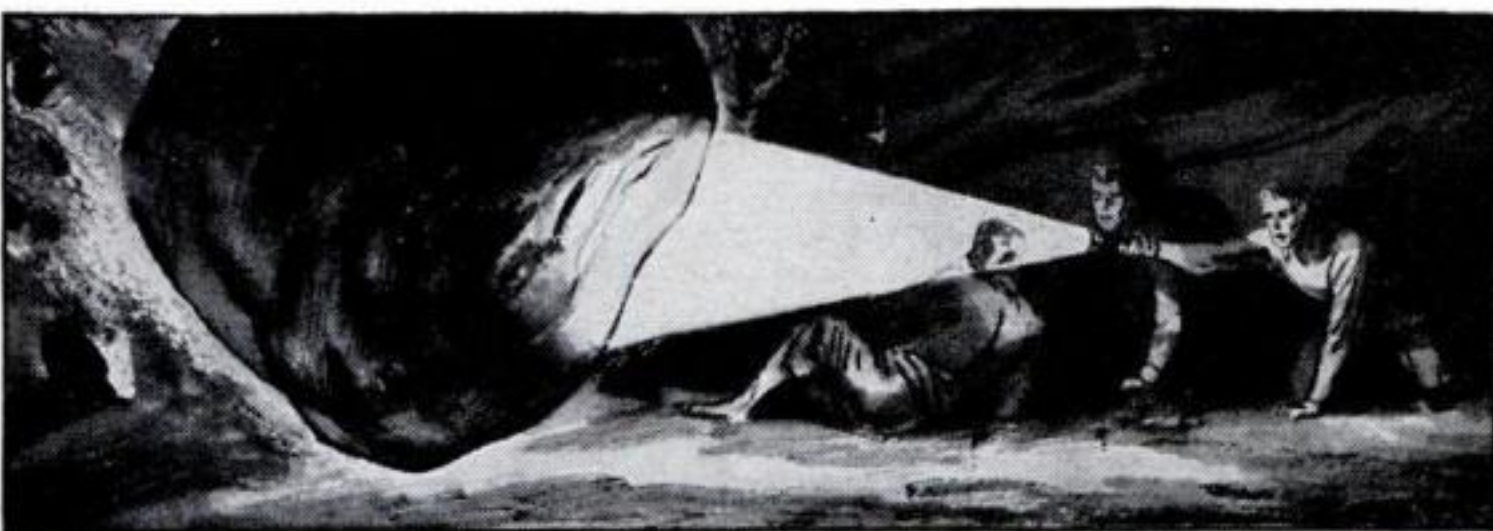
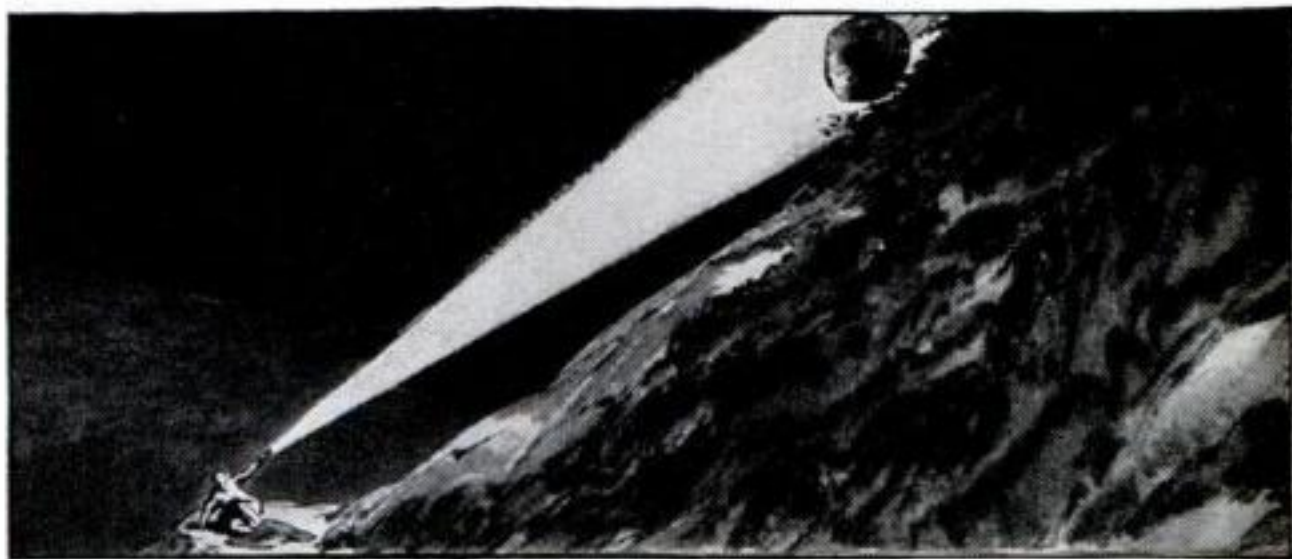


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Contents [CONTINUED]

Automobiles

Frozen-Food Delivery Trucks.....	60
Fog and Frost-Free Windows.....	134
Fast Charger for Batteries.....	134
Radio Controls Car Speed.....	134
Static Grounders for Fuel Trucks...	140
Rapid Valve-Seat Grinding.....	140
Device Shows Miles Per Gallon.....	140
Adding Machine for Car Costs.....	140
Eliminating Ventilator Glare.....	141
Improving Defroster Fans.....	141
Wiper for Inside of Windshield.....	141

Facts and Ideas

"Toasting" Saves Old Records.....	61
Balloons Speed Home Building.....	68
100-Mile-an-Hour Model Car.....	72
Atom Sorter Serves Industry.....	72
Tanks Ride on Rubber Ferry.....	81
Playing Tricks with Plants.....	110
Making Synthetic Rubber.....	114
Simple Test for Tuberculosis.....	120
Big Navy Transport Gliders.....	121

Inventions

Robots Give Arctic Weather Data...	59
One-Man Rescue Sled for Skiers....	60
Kit Holds Book-Repair Aids.....	71
Automatic Sprinklers Save Labor...	71
Device Inspects Machine Parts.....	108
Sander Has Rubber Cushion.....	108
Lawn-Mower Sharpening Aid.....	108
Gasoline-Powered Wheelbarrow....	120

Craftwork

Midget Drawknife for Carving.....	172
Leather Vacuum-Bottle Cover.....	186
Serving Tray Is Scroll-Sawed.....	187

(Continued on page 6)

IMPORTANT NOTICE: The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, Popular Science Monthly does not underwrite the business methods of the individuals or concerns producing them. To avoid liability for patent infringement, readers should investigate before making, using, or offering for sale any of the devices, machines, or processes described; Popular Science Monthly takes no responsibility. The use of Popular Science Monthly articles for stock-selling schemes is never authorized.



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Contents

[CONTINUED]

Chestnuts Form Novelty Doll Pin...	187
Modern Atlas Supports Globe.....	188
Dresser Box for Facial Tissues.....	189
Cheese Board and Plastic Knife.....	190
Modern Case for an Old Clock.....	190
Building Model Planes from Kits....	192
Cash Prizes for Tin-Can Projects....	195
Developing the Model Main Line....	196

Home Building

Repairing Exterior House Walls....	146
Modern Glass Walls in Bathrooms...	152
Plastic Caulking Comes in Coil.....	152
Strip Shingles for Random Effect....	152
Door Knocker Actuates Chimes.....	153
Reversible Paper Window Shades...	153
Quick-Action Furniture Clamp.....	153
Marble Finish Is Sprayed On.....	153
What to Do About Wet Cellars.....	162
Four-Year House-Painting Plan.....	164

Miscellaneous

Adhesive Tape Mends Upholstery...	154
Alcohol on Cloth Cleans Candles....	154
Wax Aids in Cutting Marshmallows..	154
Sharp Pencil Unseals Envelope.....	154
Tape on Can Prevents Rust Marks..	154
Filter Papers Kept on Coffee Can...	154
Oil Preserves Typewriter Ribbon...	155
Soap Cut Easily with Coping Saw...	155
Clip Holds Wire Out of the Way....	155
Range-Top Broiler and Oven Unit...	166
Ironer and Table Unit on Casters....	166
Steel Shackles Take Up Chair Sag..	166
Refrigerator-Top Storage Cabinet...	167
Collapsible Wooden Drain Board....	167
Light Hand-Model Vacuum Cleaner..	167
Ten Errors in Electric Wiring.....	184
Science Stunts with Electricity.....	198

New Shop Ideas

Tubing Bent with Salt as Filler.....	168
Rubber Edge Pads Drawing Board..	168
Wall Shelf Holds Drill Stands.....	169
Extra Blades on Hack-Saw Frame...	169
Sharpener Adapted for Draftsman...	169
Compound Rest Gives Vernier Feed..	169
Center-Drill Chucks Speed Work....	173
Expanding Mandrel for the Lathe...	174

(Continued on page 8)

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- 847 Card Games
- 855 How to Write Letters
- 856 Arithmetic Self Taught Part I
- 857 Arithmetic Self Taught Part II
- 868 Hints on Self-Improvement
- 872 Manual of Parliamentary Law
- 894 Hints on How to Advertise

Biography

- 33 Brann: Smasher of Shams
- 123 Life of Madame du Barry
- 141 Life of Napoleon
- 142 Life of Bismarck
- 253 Heart Affairs of Henry VIII
- 324 Life of Lincoln
- 343 Diary of Columbus in 1492
- 395 Autobiography of Cellini
- 412 Life of Mahomet
- 490 Life of Michelangelo
- 506 Life of Voltaire
- 522 Life of Thomas Paine
- 523 Life of Franklin
- 525 Life of Goethe
- 526 Life of Caesar
- 537 Life of Barnum
- 565 Magellan and the Pacific
- 604 Life of Roosevelt
- 718 Great Women of Antiquity
- 769 Life of Thomas Jefferson

Fiction

- 21 Carmen
- 40 House and Brain. Lytton
- 58 Tales from Decameron. Boccaccio
- 102 Sherlock Holmes Tales
- 107 The Dream Woman. Collins
- 145 Great Ghost Stories
- 277 Man Without a Country

Fine Arts

- 387 History of Painting
- 403 History of Music
- 466 History of Sculpture
- 468 History of Architecture

French Literature in English

- 3 Fourteen Little Essays. Voltaire
- 6 Love. Maupassant
- 27 Last Days of Condemned Man. Hugo
- 28 Toleration. Voltaire
- 52 Oration on Voltaire. Hugo
- 66 Crimes of Borgias. Dumas
- 85 Attack on the Mill. Zola
- 87 Love: An Essay. Montaigne
- 103 Pocket Theology. Voltaire
- 104 Battle of Waterloo. Hugo
- 178 One of Cleopatra's Nights
- 198 Majesty of Justice. France
- 199 The Tallow Ball. Maupassant
- 200 Ignorant Philosopher. Voltaire
- 221 On Women. Maeterlinck
- 292 Mademoiselle Fifi. Maupassant
- 314 Short Stories. Daudet
- 344 Don Juan. Balzac
- 866 The Piece of String and Other Stories. Maupassant
- 887 The Necklace and Other Stories. DeMaupassant
- 888 Memoirs of Madame de Stael

History

- 50 Paine's Common Sense
- 83 Marriage: Its Past, Present and Future. Annie Besant
- 126 History of Rome
- 149 Historic Crimes and Criminals
- 150 Lost Civilizations
- 214 Speeches of Lincoln
- 276 Speeches of Washington
- 558 Great Pirates. C. J. Finger
- 627 History of the Jews

Humor

- 20 Let's Laugh. Nasby
- 291 The Jumping Frog. Twain
- 382 Humor of Lincoln
- 670 Josh Billings' Comical Lexicon
- 771 The Humor of "Bill" Nye

Juvenile

- 44 Aesop's Fables
- 57 Rip Van Winkle

- 156 Andersen's Fairy Tales
- 158 Alice in Wonderland
- 188 Adventures of Munchausen
- 391 Dog of Flanders. Ouida
- 516 Book of Rea' Adventures
- 559 Robinson Crusoe
- 716 Mother Goose
- 819 A Book of Strange Murders
- 836 Bluebeard, Cinderella

Literature

- 95 Confessions of an Opium Eater
- 177 Subjection of Women. Mill
- 289 Pepys' Diary
- 513 Travels of Marco Polo
- 661 Neurotic America and the Sex Impulse. Dreiser
- 829 Voltaire. Clarence Darrow

Philosophy

- 11 A Guide to Nietzsche
- 19 Nietzsche: Who He Was
- 96 Dialogues of Plato
- 153 Chinese Philosophy of Life
- 159 Guide to Plato
- 414 Art of Happiness. Powys
- 520 A Guide to Spinoza. Durant
- 671 Moral Discourses of Epictetus

Religion

- 4 The Age of Reason. Paine
- 61 What is Religion? Tolstoy
- 184 Primitive Beliefs
- 593 As a Man Thinketh
- 600 The Essence of the Bible
- 636 The Greatest Thing in the World
- 684 Essence of Judaism

Russian Literature (In English)

- 24 The Kiss. Chekhov
- 45 Tolstoy's Short Stories
- 100 The Red Laugh. Andreyev
- 105 Seven Hanged. Andreyev
- 239 26 Men and a Girl. Gorky

Science

- 53 Insects and Men: Instinct and Reason
- 92 Hypnotism Made Plain
- 190 Psycho-Analysis: The Key to Human Behavior
- 217 The Puzzle of Personality
- 447 Auto-Suggestion
- 491 Psychology for Beginners
- 524 Death: and Its Problems
- 555 Structure of the Earth
- 679 Chemistry for Beginners
- 727 Psychology of Affections
- 761 Food and Diet
- 804 Freud on Sleep and Sexual Dreams
- 876 Curiosities of Mathematics

Social Hygiene

- 14 What Every Girl Should Know
- 74 Physiology of Sex Life

- 91 Manhood: The Facts of Life
- 98 How to Love. Wood
- 172 Evolution of Sex. Wood
- 189 Eugenics Made Plain
- 203 Love Rights of Women
- 648 Rejuvenation—Fountain of Youth. Fielding
- 651 How to Psycho-Analyze Yourself
- 653 What Boys Should Know. Fielding
- 654 What Young Men Should Know
- 655 What Young Women Should Know
- 656 What Married Men Should Know
- 657 What Married Women Should Know
- 689 Woman's Sexual Life
- 690 Man's Sexual Life
- 691 The Child's Sexual Life
- 717 Modern Sexual Morality
- 726 Simple Facts About Venereal Diseases
- 782 Psycho-Analysis and the Mind and Body. Bonus
- 784 Tests Used in Psycho-Analysis
- 800 Sex in Psychoanalysis
- 864 Confidential Chats With Husbands

Miscellaneous

- 986 How to Talk and Debate
- 987 The Art of Kissing
- 988 The Art of Courtship
- 1003 How to Think Logically
- 1009 Typewriting Self Taught
- 1012 Best Negro Jokes
- 1013 Best Irish Jokes
- 1014 Best American Jokes
- 1018 Humorous Limericks
- 1023 Popular Recitations
- 1069 Conquest of Fear
- 1070 How to Fight Nervous Troubles
- 1078 Morals in Greece and Rome
- 1093 Amusing Puns
- 1097 Memory: How to Develop It
- 1109 Spanish Self Taught
- 1126 Eating for Health
- 1170 Funny Ghost Stories
- 1176 A Mad Love
- 1184 Book of Best Scotch Jokes
- 1207 French Self Taught
- 1221 Facts About Will Power
- 1228 Best Jokes About Drunks
- 1231 Book of Best Jokes
- 1249 Best Jokes About Lovers
- 1292 Best Short Stories
- 1320 How to Get a Husband
- 1333 Common Sense of Health
- 1340 How to Get a Job
- 1342 Typical Love-Problems
- 1354 Book of Striking Similes
- 1430 Shorthand Self Taught
- 1434 How to Think Clearly
- 1475 Book of Best Jokes
- 1562 How to Live Long
- 1710 The Magic of Numbers
- 1712 Great Dates in History
- 1714 Determinism vs. Free Will
- 1715 Funeral Services Without Theology
- 1717 Religion and Progress
- 1719 Inge's Apology for Christianity
- 1721 Gambler's Luck
- 1739 Hints on Developing Personality
- 1753 Why Many Women Are Unattractive
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Contents [CONTINUED]

Outdoors

- [Make Your Own Fishing Flies..... 156](#)
- [Tie-Down Stakes with Screw Ends... 160](#)
- [Sharp Nail Clipper Trims Flies..... 160](#)

Photography

- [Synchronized Sunlight for Photos... 206](#)
- [Enlarger with Power-Cooled Unit... 211](#)
- [Pocket Folders Hold Minicolors.... 211](#)
- [Sound-on-Ribbon Home Recorder... 211](#)
- [Camera Making—a Precision Job... 212](#)
- [Lamp Illuminates Trimming Board.. 214](#)
- [Reminder on Synchronizer Knob.... 214](#)
- [Aid in Preventing Wasted Film..... 214](#)
- [Grease on Pane Softens Portraits.... 215](#)
- [Enlarging-Paper Test Negatives.... 216](#)
- [Color Prints from New Roll Film... 231](#)

Radio

- [Two-Way Radio Station Costs \\$18... 200](#)
- [Cactus Needles Sharpened on Disk.. 204](#)
- [Coaxial Speakers Blend FM Sounds. 204](#)
- [Phototube Bounces Electrons..... 204](#)
- [Collapsible Emergency Antenna.... 205](#)
- [Multicoupler-Antenna Wall Plug.... 205](#)

Shop Data File

- [Replacing a Flatiron Element..... 161](#)
- [Transferring Printed Matter..... 161](#)
- [Helix Angle for Acme Threads..... 168](#)
- [Planing Thin Stock on Bench Hook.. 179](#)
- [Electroplating, Part 9..... 185](#)

The Handy Man

- [Chain Cleans Rusty Water Tank..... 155](#)
- [Large-Capacity Closet Shoe Rack... 155](#)
- [Foot Switch on Three-Way Lamp... 184](#)
- [Automatic Electric Door Opener.... 185](#)

Woodworking

- [Durable Plywood Tool Cabinet..... 170](#)
- [Making Table Legs on the Lathe.... 176](#)
- [Typewriter Desk for Home Use..... 180](#)
- [Designs for Wooden Table Lamps... 182](#)
- [Tested Blueprints for the Shop..... 227](#)

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Thus, the selectee who is a Draftsman, a Radio Expert, a Stenographer, a Machinist, a Surveyor, an Automotive Technician, an Electrician, or who has *training* in some other field, stands a far better chance of reaching quickly "non-com" or "Specialist" grades than the man without training in any phase of Army work.

Where do you fit into this picture?

When your number's called, will you be another "Rear Rank Rudy," drawing the lowest base pay — or will you be qualified through *sound, modern training* for the much higher "N. C. O." or "Specialist" pay rates?

If you've ever thought of getting the training you lack—*now's the time!* For a few dollars a month, you can study an I. C. S. Course in your spare time, at home, and prepare yourself — not just for a more important Army job — but for *success* in civil life!

This coupon will bring you complete information, at no cost or obligation. For thousands of successful men, mailing it has been the most important act in their lives! Will you invest a 3c stamp—*now*—to learn how you can benefit?

INTERNATIONAL CORRESPONDENCE SCHOOLS

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★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the course *before* which I have marked X: ★

TECHNICAL AND INDUSTRIAL COURSES

- | | | | |
|--|--|---|--|
| <input type="checkbox"/> Air Brake | <input type="checkbox"/> Contracting and Building | <input type="checkbox"/> Marine Engines | <input type="checkbox"/> Sanitary Engineering |
| <input type="checkbox"/> Air Conditioning | <input type="checkbox"/> Cotton Manufacturing | <input type="checkbox"/> Mechanical Drafting | <input type="checkbox"/> Sheet Metal Work |
| <input type="checkbox"/> Airplane Drafting | <input type="checkbox"/> Diesel Engines | <input type="checkbox"/> Mechanical Engineering | <input type="checkbox"/> Ship Drafting |
| <input type="checkbox"/> Architectural Drafting | <input type="checkbox"/> Electrical Drafting | <input type="checkbox"/> Mine Foreman | <input type="checkbox"/> Shipfitting <input type="checkbox"/> Shop Practice |
| <input type="checkbox"/> Architecture | <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Navigation | <input type="checkbox"/> Steam Electric <input type="checkbox"/> Steam Engines |
| <input type="checkbox"/> Auto Engine Tune-up | <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Patternmaking <input type="checkbox"/> Plumbing | <input type="checkbox"/> Steam Fitting |
| <input type="checkbox"/> Auto Technician | <input type="checkbox"/> Foundryman <input type="checkbox"/> Heating | <input type="checkbox"/> Practical Telephony | <input type="checkbox"/> Structural Drafting |
| <input type="checkbox"/> Aviation <input type="checkbox"/> Aviation Mechanic | <input type="checkbox"/> Heat Treatment of Metals | <input type="checkbox"/> Public Works Engineering | <input type="checkbox"/> Structural Engineering |
| <input type="checkbox"/> Boilermaking | <input type="checkbox"/> Highway Engineering | <input type="checkbox"/> Pulp and Paper Making | <input type="checkbox"/> Surveying and Mapping |
| <input type="checkbox"/> Bridge Engineering | <input type="checkbox"/> House Planning | <input type="checkbox"/> Radio, General | <input type="checkbox"/> Telegraph Engineering |
| <input type="checkbox"/> Chemistry | <input type="checkbox"/> Industrial Metallurgy | <input type="checkbox"/> Radio Operating | <input type="checkbox"/> Telephone Work |
| <input type="checkbox"/> Civil Engineering | <input type="checkbox"/> Locomotive Engineer | <input type="checkbox"/> Radio Servicing | <input type="checkbox"/> Textile Designing |
| <input type="checkbox"/> Coal Mining | <input type="checkbox"/> Machinist | <input type="checkbox"/> R. R. Section Foreman | <input type="checkbox"/> Toolmaking <input type="checkbox"/> Welding |
| <input type="checkbox"/> Concrete Engineering | <input type="checkbox"/> Management of Inventions | <input type="checkbox"/> R. R. Signalman <input type="checkbox"/> Refrigeration | <input type="checkbox"/> Woollen Manufacturing |

BUSINESS COURSES

- | | | | |
|--|--|--|---|
| <input type="checkbox"/> Accounting <input type="checkbox"/> Advertising | <input type="checkbox"/> College Preparatory | <input type="checkbox"/> First Year College | <input type="checkbox"/> Railway Postal Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Commercial | <input type="checkbox"/> Foremanship <input type="checkbox"/> French | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Business Correspondence | <input type="checkbox"/> Commercial Illustrating | <input type="checkbox"/> Good English | <input type="checkbox"/> Secretarial <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> High School | <input type="checkbox"/> Showcard and Sign Lettering |
| <input type="checkbox"/> Cartooning <input type="checkbox"/> Civil Service | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Traffic Management |

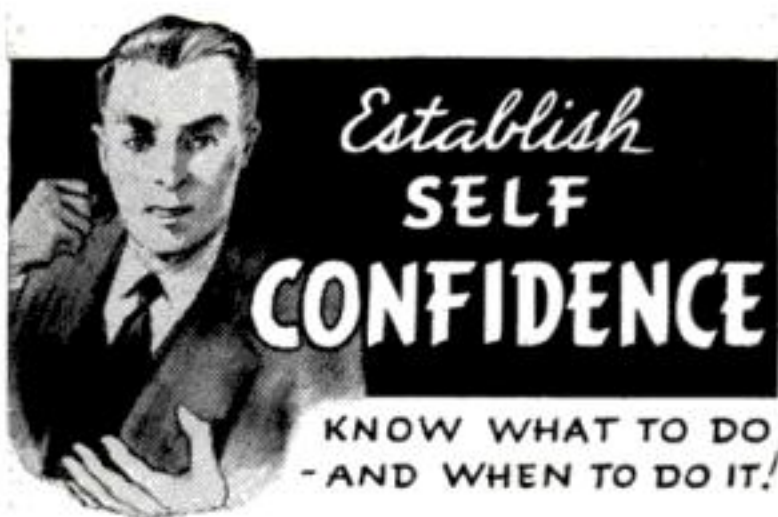
HOME ECONOMICS COURSES

- | | | |
|---|---|---|
| <input type="checkbox"/> Advanced Dressmaking | <input type="checkbox"/> Home Dressmaking | <input type="checkbox"/> Tea Room and Cafeteria |
| <input type="checkbox"/> Foods and Cookery | <input type="checkbox"/> Professional Dressmaking and Designing | <input type="checkbox"/> Management, Catering |

Name.....Age.....Address.....

City.....State.....Present Position.....

Canadian residents send coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England



IS YOUR faith in yourself shaken? Can you adjust yourself to the changing times? Have you found your plans and enterprises suddenly thwarted by the unexpected—robbing you of confidence? You do not have to be a prophet to know what is coming—or a miracle worker to make the most of an opportunity. Just as straws in the wind show its directions, so you can learn from the things people do what their moods and fancies are—and use them to your good advantage. If you once know human nature—its traits and psychological tendencies—you will have a *confidence*, born of knowledge, and *equal to every situation*.

ACCEPT THIS *Free* BOOK

For several centuries the Rosicrucians—a world-wide Fraternity—have made a study of these *functions of mind* and their relationship to human conduct in the world in which we live. To thousands of men and women they have made life less mysterious—and *success and happiness* more assured. Write today for a free copy of the book, *The Secret Heritage*. It contains no strange formulas, but tells how you may have these beneficial teachings for study in the privacy of your home.



The ROSICRUCIANS (AMORC)
ROSICRUCIAN PARK SAN JOSE, CALIF.

Scribe C. I. M.
The Rosicrucians, San Jose, California

I am sincerely interested in an intelligent method for attaining a mastership of life. Send me without obligation, your FREE Book which explains how I may receive and use your age-old method.

Name.....

Address.....

Coming Next Month—

OLD MAN RIVER is losing his kinks! To shorten hauls in important inland-waterways traffic, engineers have tackled a job that makes the labors of Hercules look like a spare-time hobby—straightening the meandering Mississippi. Hydraulic dredges are biting off tongues of land to make short cuts for barges carrying defense materials. Methods and machines used in remaking the map are described in a timely article.

MASTER OF LETTERS is Frederic W. Goudy, recognized throughout the world as one of the greatest designers of printing type of all time. In "Type by Goudy," Andrew R. Boone lets you look over the shoulder of this great craftsman as he creates one of the 100-odd beautiful type faces with which he is leaving his imprint on the history of his time.

WATER PAINTS offer the home owner a convenient and economical material for many finishing jobs around the house. Prepared by simply adding water, they are easily applied and dry in minutes. An article by Maurice Wharton, accompanied by handy chart and tables, tells how to use water paints to best advantage for various purposes.

WHAT'S IT LIKE to be a dive bomber? To find out for readers of *Popular Science*, Hickman Powell crawled into the machine-gunner's seat behind one of Uncle Sam's flyers and went out with him to bomb a hypothetical motorized column. His account of that breath-taking plunge will make you hold onto your chair!

ASSEMBLING A BIG GUN is quite a job, even when it's done in the comparative peace and quiet of a factory. But the Army's 240-mm. mobile howitzer travels up to the front in sections on tractor-towed trailers and is set up for action overnight by its highly trained crew in the pitch-darkness of a blackout. Pictures show this front-line assembly line at work under combat conditions.

DESTROYERS are in the news today, and ship-model makers will welcome a greatly simplified miniature model of a vessel of the Mayo class, of which 24 were commissioned in 1940 and 1941. These ships, which include the famous *Kearny*, have played a vital part in the war on the sea. In its simplified form, the model can represent any ship of the class.

Do You Want Success Like This in RADIO



BEFORE COMPLETING YOUR COURSE I OBTAINED MY RADIO BROADCAST OPERATOR'S LICENSE AND IMMEDIATELY JOINED STATION WMPC WHERE I AM NOW CHIEF OPERATOR.

HOLLIS F. HAYES
327 MADISON ST., LAPEER, MICH.



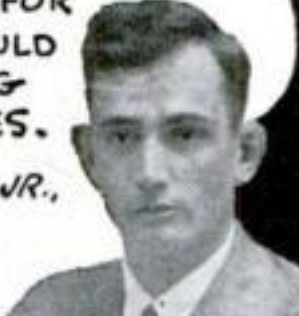
I WAS WORKING IN A GARAGE WHEN I ENROLLED WITH N. R. I. I AM NOW RADIO SERVICE MANAGER FOR M.----- FURNITURE CO. FOR THEIR 4 STORES.

JAMES E. RYAN
119 PEBBLE COURT
FALL RIVER, MASS.




CLIPPING YOUR COUPON GOT ME STARTED IN RADIO. I AM NOW IN CHARGE OF THE RADIO DEPARTMENT FOR THE AMERICAN AIRLINES AT CLEVELAND.

WALTER B. MURRAY
AMERICAN AIRLINES, MUNICIPAL AIRPORT, CLEVELAND, OHIO.




MY LOUDSPEAKER SYSTEM PAYS ME ABOUT \$35 A WEEK BESIDES MY RADIO WORK. IF IT HAD NOT BEEN FOR YOUR COURSE I WOULD STILL BE MAKING COMMON WAGES.

MILTON I. LEIBY, JR.
TOPTON, PA.



I HAVE BEEN IN BUSINESS FOR MYSELF FOR TWO YEARS, MAKING BETWEEN \$200 AND \$300 A MONTH. BUSINESS HAS STEADILY INCREASED.

ARLIE J. FROEHNER
300 W. TEXAS AVE.
GOOSE CREEK, TEX.



I MAKE \$40 A MONTH FIXING RADIOS IN SPARE TIME. I STARTED MAKING EXTRA MONEY 3 MONTHS AFTER BEGINNING THE N. R. I. COURSE AND MADE ABOUT \$100 WHILE LEARNING.

WILLIAM CHERMAK
RT. 1, BOX 287
HOPKINS, MINN.

Here's The Formula That Has Worked For Hundreds

If you're looking for a quick way to better pay, and a chance to get a good, permanent job in a field of real opportunity, here's the formula that has worked for the men you see above, and hundreds of others, too. It's not a "miracle cure" nor a "long-chance" operation. It is a time-tested, practical way to make \$5 to \$10 a week extra a few months from now, and to prepare for a full-time job paying up to \$50 a week as a Radio Technician or Radio Operator.

Beginners Train at Home to Make \$30, \$40, \$50 a Week

On top of increasing civilian interest in Radio, the Radio Industry is rushing to fill hundreds of millions of dollars' worth of Government Orders. Over 800 Broadcasting stations in the U. S. employ thousands of Radio Technicians and Radio Operators with average pay among the country's best paid industries. Repairing, servicing, selling home and auto Radio receivers (there are more than 50,000,000 in use) gives jobs to thousands. Many other Radio Technicians take advantage of the opportunities to have their own service or retail Radio business. Think of the many good pay jobs in connection with Aviation, Commercial, Police Radio and Public Address Systems. N. R. I. trains you to be ready when Television opens new jobs.



Extra Pay in Army, Navy Too



Every man likely to go into military service, every soldier, sailor, marine, should mail the Coupon Now! Learning Radio helps men get extra rank, extra prestige, more interesting duty at pay up to 6 times a private's base pay.

Many Make \$5 to \$10 a Week Extra in Spare Time While Learning

Nearly every neighborhood offers opportunities for a good part-time Radio Technician to make extra money fixing Radio sets. I give you special training to show you how to start cashing in on these opportunities early. You get Radio parts and instructions for building test equipment, for conducting experiments that give you valuable practical experience. You also get a modern Professional Radio Servicing Instrument. My fifty-fifty method—half working with Radio parts, half studying my lesson texts—makes learning Radio at home interesting, fascinating, practical.

Find Out How I Train You For Good Pay in Radio

Mail the coupon below, I'll send my 61-page book FREE. It tells about my Course; the types of jobs in the different branches of Radio; shows letters from more than 100 of the men I trained so you can see what they are doing, earning. MAIL THE COUPON in an envelope or paste on a penny postal.

J. E. Smith, President
Dept. 2CP3, National Radio Institute
Washington, D. C.



**I Trained These
Men at Home
I Will Train
You Too**

THIS FREE BOOK HAS SHOWN HUNDREDS HOW TO MAKE GOOD MONEY

J. E. SMITH, President, Dept. 2CP3
National Radio Institute, Washington, D. C.

Mail me FREE without obligation, your 61-page book "Rich Rewards in Radio." (No salesman will call. Write plainly.)

Age.....

Name.....

Address.....

City.....State.....



*From the
News Editor's
Desk*

COTTON BY-PRODUCTS such as hull shavings and the waste from ginning, carding, and other cleaning operations, can now be used to make the finest bond and writing papers. This process is made possible by the use of a new commercial chemical, sodium chlorite. When boiled with this chemical, in combination with certain others, even the most discolored fibers come out after bleaching, entirely clean and may be used to produce paper equal to that made from rags.

PROTECTION AGAINST SIX DISEASES prevalent during the first World War is now possible by newly developed vaccines and toxoids. Yellow fever, often fatal to troops fighting in the tropics, can be controlled by a new vaccine. Tetanus and gas-gangrene are now practically eliminated by the use of toxoids. Three new vaccines that may prove of great value in the present war have recently been developed for influenza, typhus fever, and measles.

THE THEORY that all substances were made from 92 chemical elements received a rude jar when a radioactive element No. 93, neptunium, was discovered by Prof. Enrico Fermi of Italy and Columbia University. Mathematical formulas just worked out by a colleague, Dr. M. G. Mayer, now indicate that there may well be a whole group of unknown elements, of the "rare earth" type like neptunium, beyond the position of uranium in the present list.

SCIENTIFIC STUDY OF BODY MEASUREMENT may simplify the buying and selling of women's clothes during the busy war era. With economy in mind, clothing manufacturers will mark dresses and other garments according to weight, height, and shape instead of the conventional size range. Fourteen thousand women, from 18 to 80, were measured and weighed in a recent WPA project in an attempt to find the average proportions of adult American women.

BAKING LIGHTER BISCUITS may be the result of a discovery reported to the American Chemical Society. By thinly coating the acid constituent of baking powder with hydrated monocalcium phosphate, the penetration of water to the acid is delayed, thereby slowing its reaction with the bicarbonate of soda. Because of this, the carbon dioxide gas which raises the dough is produced at a time when it has the maximum effect and, as a result, you have a fluffier bit of baking.

The *NEW* OPPORTUNITY in .. ACCOUNTING ..

—and how *YOU* can take advantage of it

NEVER before has there been as great an opportunity as now faces efficient bookkeepers and accountants.

You know, of course, that accounting has always been a profession of outstanding opportunity—a field in which the capable, trained man could go faster and farther than in almost any other field. But we believe that all past opportunities are going to be surpassed in the next five years.

And here's why:

In the first place, the defense situation has accelerated and complicated business. Hundreds of new plants, hundreds of others expanded, priorities, shortages of raw materials, some companies shifting to new products, and millions more men at work necessitate more bookkeeping and accounting—both by government bodies and by private industry.

Then our governmental policy forces the keeping of better and more complete records in every office and plant. It is not a matter of choice with any firm—it is necessity.

For instance Federal Securities Act, with its insistence upon publicity of *complete* facts about every company selling its securities publicly, compels more frequent and more accurate financial state-

ments—and these in turn call for more and better accounting.

Then the Social Security tax, the unemployment regulations, the Wages and Hours Act, the Excess Profits tax and other taxes necessitated by national defense—all center around more complete accounting records.

Thus there is an insistent and growing demand for bookkeepers and accountants, a demand that already exceeds the supply and is still growing. This goes all the way along the line from routine bookkeepers to executive accountants. And it seems likely to increase much farther.

Ask for the Facts

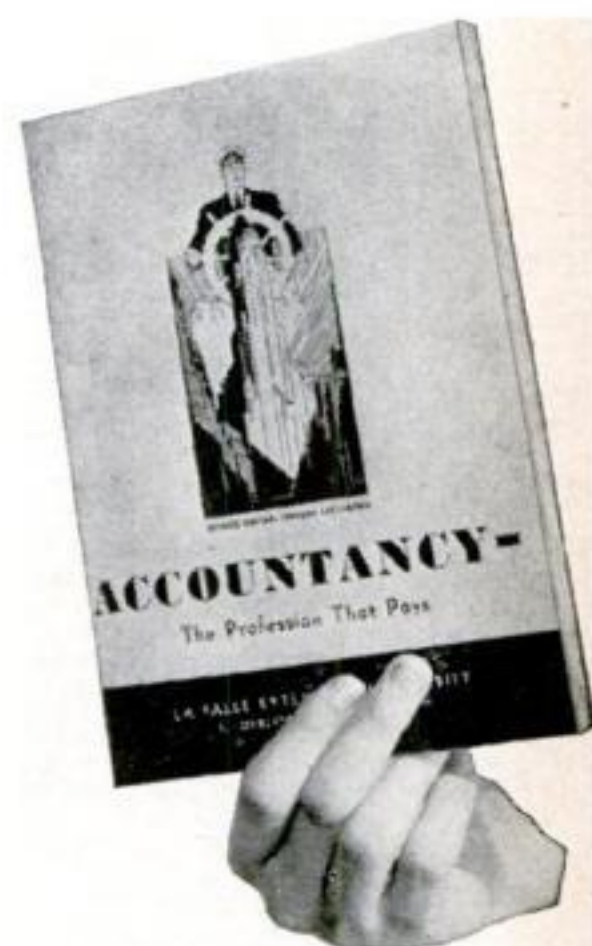
We need not tell you what that means in opportunity for the capable man already in accounting and for the able man who gets into accounting now. Nor need we argue for the practicality and value of LaSalle training in Accountancy—over 500,000 men and women, and 2,000 C. P. A.'s have already tested and proved that.

The only question is about *you*—whether you fit into this field and whether you can and will prepare yourself adequately. For accounting is no magic wand to

summon success—it demands much from the man whom it rewards highly.

You can answer that question wisely only when you know the facts. And the coupon below will bring you full facts about these demands and opportunities in accounting today together with the details about the LaSalle home-study training in Accountancy.

If you are dissatisfied with your present situation—and in earnest about achieving success—get the facts—use the coupon—NOW.



I'd like to see whether I should take up accountancy. Send me, without obligation or cost to me, your booklet, *Accountancy, the Profession That Pays*, and full information about your Accountancy Training program.

☐ Higher Accountancy

LASALLE
EXTENSION
UNIVERSITY

Dept. 383-HR, Chicago
A CORRESPONDENCE
INSTITUTION

Other LaSalle Opportunities:

If more interested in one of the fields indicated below, check and mail now.

- | | | |
|--|---|--|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Commercial Law | <input type="checkbox"/> Business Correspondence |
| <input type="checkbox"/> Modern Salesmanship | <input type="checkbox"/> Modern Bookkeeping | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Law—Degree of LL.B. | <input type="checkbox"/> C. P. A. Coaching | <input type="checkbox"/> Stenotypy |

Name.....Age.....

Present Position.....

Address.....

Readers Say:

Couldn't Wait for Plans, So He Made His Own

HERE is a photograph of some of the recreation-room furniture we constructed for the 45th Medical Battalion, Third Armored Division, Camp Polk, La. After writing to you for plans, I sketched some pieces and we built a few to see how they would look. They were so darn good that we did not wait for your drawings but started in to manufacture them in a wholesale way. These pieces are made out of old scrap tongue-and-groove yellow pine left over from the construction of the barracks. We made master patterns for each piece and put some of the boys to work. These men had no previous experience as carpenters. When the sawdust cleared away, we had 134 tables, straight-back chairs, arm-chairs, and settees. All have been neatly sanded, stained, and varnished.—Lt. Col. F. T. Chamberlin, U. S. A.



Samples of the 134 pieces of furniture designed by Lt. Col. F. T. Chamberlin and constructed by inexperienced men to furnish the "day rooms" of the 45th Medical Battalion, Third Armored Division, Camp Polk, La. Only scrap lumber was used

Photographers: What Do You Do with Your Empty Film Spools?

I've been reading your magazine for quite some time. It's about the best magazine



published. I like the articles on photography best of all, and my only complaint is that there isn't more on this subject. I've been developing my own pictures for some time and, as I can't bear to throw anything away, I have been saving my empty film spools. I've collected a pretty big pile of them. I would like

to ask your readers if they have any good ideas as to what I could do with them. I'd be much obliged for any suggestion because I hate to throw them out.—H. A., Manchester, N. H.

Wrong Wright Plane Shown in "Here's My Story"

YOUR account of the career of Maj. Gen. H. H. Arnold in "Here's My Story" in your October 1941 issue is most interesting and historically correct as to dates, etc., but I

feel you owe it to your readers through your Readers Say column to let them know that your illustrations Nos. 2, 3, and 5 are incorrect. When General Arnold learned to fly in 1911 at the Wrights' school in Dayton, he did not learn in a Wright plane of 1909 vintage; neither did he make his 140 flights during his first year in such a plane. In 1912 when he won the Mackay trophy, he did not fly such a plane as you have pictured. The Wright brothers did not use landing skids on their planes of 1911 and 1912; neither did they use front elevators as you have shown in these pictures—they adopted rear elevators and landing wheels in 1910. The writer knows, for in 1912 he was flying in a Wright plane and it had rear elevators and wheels for take-off and landing, and he also knows that the Wrights made these changes in 1910.—W. H. S., Philadelphia, Pa.

Sometimes We Are Funny Without Trying to Be

I HAVE been reading your magazine for two or three years now and I think it very good. I have just one suggestion to make, and that is for you to put a few jokes in your magazine. Since this is the only magazine I read, I sometimes feel the lack of a little humor.—W. E. L., Salina, Kans.

HEY, WE "LITTLE MEN" THOUGHT WE WERE FUNNY!



Make Bigger Money Now! in AUTO REPAIR WORK

*More Repairs Now
Needed Every Day,
to Keep America's
Cars Rolling!*

**This PARTIAL Table of Contents
Can Only HINT at This Book's
Many THOUSANDS of Uses to You**

TUNE-UP

Step-by-step instructions for tuning-up all modern cars.

CARBURETORS

50 pages of text, charts, illustrations covering all models, with alphabetical index showing make, type and part number of carburetor used on each model of car.

AUTOMATIC CHOKES
FUEL PUMPS
GASOLINE GAUGES
GENERATOR
CONTROLS
HEADLAMPS
CLUTCHES
BRAKES
BRAKE BOOSTERS
UNIVERSALS
REAR END
STEERING
WHEEL ALIGNMENT
SHOCK ABSORBERS

30 Makes of Cars

Divided by makes into separate chapters, pages 186 to 603 give step-by-step instructions for all service jobs on each of the 502 models of passenger cars produced between 1935 and 1942, and main facts needed to service 405 models of trucks.

Tables

All important specifications, clearances, measurements, etc., are arranged in quickly understood tables at beginning of

**Car Owners—Have Your Service Repair Shop
Check Your Car Today. Keep 'em Rolling!**

each chapter. These include:

GENERAL DATA
TUNE-UP CHART
TORQUE WRENCH
READINGS
VALVE
MEASUREMENTS
COMPRESSION
PRESSURE
ENGINE
CLEARANCES
MAIN & ROD BEARING JOURNAL
DIMENSIONS
GENERATOR
STARTING MOTOR
CLUTCH AND BRAKE
SPECIFICATIONS
FRONT END
MEASUREMENTS
LUBRICATION AND
CAPACITY CHART

Detailed Instructions

Easily understood text, with hundreds of photographs and drawings, describes exact "how-to-do-it" of such repairs, adjustments, replacements as call for special work. Main subjects covered include:

ENGINE
ELECTRIC SYSTEM
FUEL SYSTEM
COOLING
LUBRICATION
CLUTCH
TRANSMISSION
UNIVERSALS
REAR END
WHEELS
BRAKES
FRONT END
KNEE ACTION
SHOCK ABSORBERS
STEERING
SPRINGS
BODY
FREE WHEEL
OVERDRIVE
FLUID COUPLING
Etc., Etc.

**Now You Can Do ANY Job on ANY Model or Make of
Car from 1935 to 1942—With This Greatest Manual
of Clear, Simple, Official Instructions Ever Published!**

ENORMOUS demand for repair work is pounding at shop doors right NOW! Millions of cars MUST be made to last years longer. More jalopies on road mean more crack-ups, too.

Car repairs, replacements, overhauling are needed now as never before. The man today who can fix ANY make of car is in the money—whether garage-owner, shop foreman, mechanic, instructor—or student.

502 Car Models

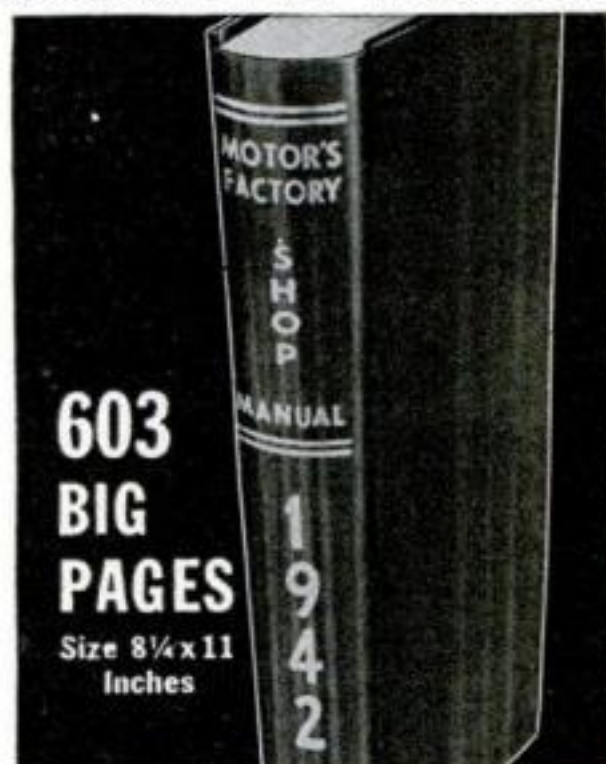
Here, in one amazing volume, is everything you want to know about EVERY repair, tune-up job, on EVERY American car made since 1935. (502 models, including all 1942's, plus major data for servicing 405 trucks!) Here is the most complete, easy-to-understand, authoritative shop manual in existence!

Step by step, MoToR's 1942 Factory Shop Manual, JUST PUBLISHED, tells you exactly what to do. It shows you, in more than 900 Photos, Drawings, Diagrams. It gives you over 450 Charts and Tables to make every job a precision job.

Like 150 Factory Books in ONE!

Imagine a COMPLETE COLLECTION of ALL the official shop procedure manuals, prepared by each car manufacturer's own engineers! That's what you GET in this book!—with everything boiled down to clearest, easiest-to-use form, and all quick-indexed.

You can save shop hours, make money faster, turn out better jobs, build sure-fire repeat customers, with this great book. And don't forget, the delighted customer is the surest gas, oil, and accessories buyer, too!



**Over 200,000 "How-to-Do-It" Facts on
Every Problem of Tune-Up and Repair
More Than 450 Charts and Tables
Over 900 Photos, Drawings, Diagrams**

Defense has drafted thousands of skilled mechanics. Men still on the job MUST know how to handle anything that comes in, without turning down a single customer. Here is how you can do it!

SEND NO MONEY

Satisfaction Guaranteed

Simply fill out coupon below. Mail it TODAY. Your copy of MoToR's 1942 Factory Shop Manual will be sent at once. When postman delivers it, pay him only \$4 plus few cents postage costs, on the ironclad Money-Back Guarantee printed in coupon. For more jobs, more money, rush this now to: MoToR BOOK DEPT., Room 2509, 572 Madison Avenue, N. Y. C.

MoToR BOOK DEPARTMENT, Room 2509, 572 Madison Avenue, New York, N. Y.

Please rush me a copy of MoToR's 1942 Factory Shop Manual. I will pay postman \$4 plus few cents delivery charges, with understanding that if the Manual does not fully satisfy me, I may return it within 7 days (and in original condition) for full refund.

NAME _____

ADDRESS _____

CITY _____ STATE _____

YOUR JOB: _____

☐ Put X here if enclosing \$4 (check, money order) WITH this coupon. WE will then pay all postage. Same 7-day Money-Back Guarantee.

CHAMPION SPARK PLUGS

Readers Say:

P.S.M. Helps Him Keep Abreast of Military Developments

It is a pleasure to let you know that I think your magazine is continually improving its editorial presentation. Beginning, I believe, with your change to a smaller format, a new pictorial presentation has become very effective. Series pictures tell a good story, but it is the accompanying articles that give definite information. The present proportion of picture articles to illustrated articles is very satisfactory, to my way of thinking. During the ten years that I have subscribed to your magazine, I have been interested in home-workshop articles, and believe that these and the longer opening articles are the two important divisions of the magazine. Your series of articles in the past year on the Army and Navy have been outstanding. As a Reserve Officer in training, I can find articles that keep me abreast of new developments in Army equipment that are not available from any other sources. Army magazines are devoted to technical discussion for the most part, and are surely of value, but to know what is new and what the other branches of the Army are doing, POPULAR SCIENCE is outstanding and in fact unique. I like what you are doing now and, may I add, especially those color photographs on the covers.—D. D. W., Lincoln, Neb.

*More Vital-
More Dependable
than ever!*



You're looking at the heart and pulse of an engine—its spark plugs. So little, but oh so vital to the best engine performance, economy and dependability, it's poor practice to neglect them, or use any but the best.



If, like most motorists today, you are demanding longer and better service from your car, have your spark plugs checked and cleaned regularly in the Champion Spark Plug Service Unit. Remember, old, worn-out, or carbon encrusted spark plugs rob your car of economy and efficiency.



There is no substitute for quality and reputation, and Champion Spark Plugs are true "Champions" the world over. Champion spark plugs are backed by research, experience, and engineering resources without equal.

TO SAVE GASOLINE • KEEP YOUR SPARK PLUGS CLEAN

**Model Builders
Attention!**



	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion has designed 3 spark plugs for model gas engines which give the same dependable performance as regular Champions. Silliment sealed. Alloy needlepoint

electrodes for easy starting. One piece construction.

CHAMPION
SPARK PLUG CO.
901 Upton Ave.
Toledo • Ohio

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R. E. BRANDEL, Editor

They Keep On Earning Money by Easy Electroplating



THE MAN who dreams of earning extra money, as much as \$50 or \$60 per week, need not dream in vain. Brush electroplating offers that opportunity. Here's what Jasper Brown of Chicago says: "I bought my electroplater to experi-

ment with during my spare time. In a few evenings I earned the cost of the machine by plating jewelry, silverware, headlight reflectors, etc., for friends and neighbors. Now I have all I can do. I recommend this machine to all who want a profitable business."

Jasper Brown is headed for a business of his own, apparently. Restaurants, music stores, doctors, dentists and garages are only a few of the many sources of business for the electroplater who wants to hear more cash jingling in his pocket.

J. J. Wilson, Slidell, La., writes: "After I received my electroplater I practiced for about an hour. I made up four samples and went out after business. One of the large chain restaurants now has me do all their silverware."

Max Hemmert, Idaho Falls, Idaho, states: "I am now spending all my time in plating work. I purchased a brush plater last summer and have worked up a very promising business."

Frank Welde, Philadelphia, goes after garage business. He writes: "I electroplated a few brass strips for samples. I then showed these strips to different people and that's how I got plenty of jobs. I have all the work from a big garage. The owner gets 10% of what is charged his customers, and the rest goes to me for my work."

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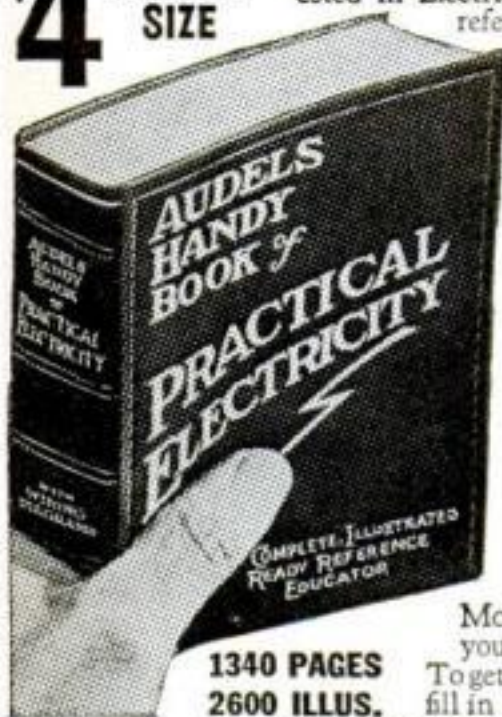
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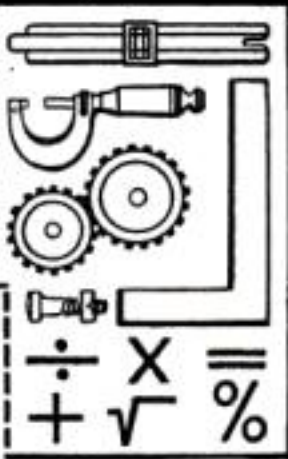
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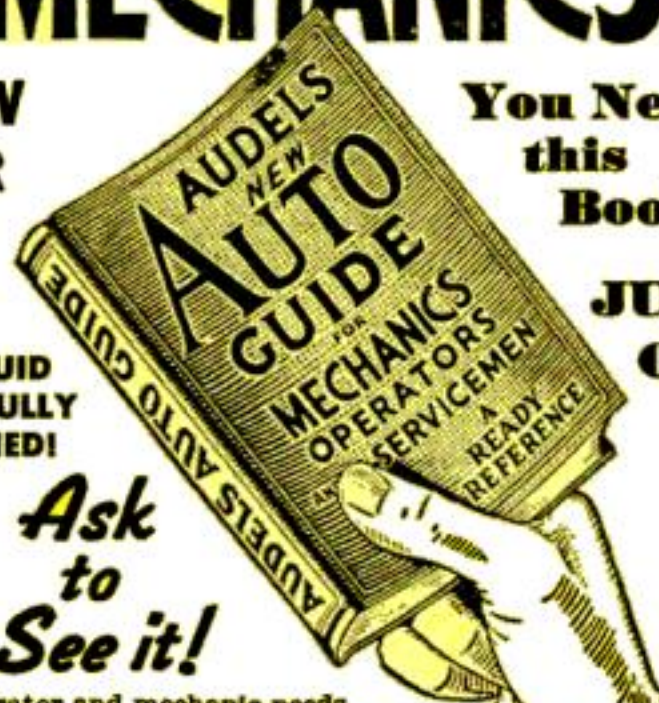
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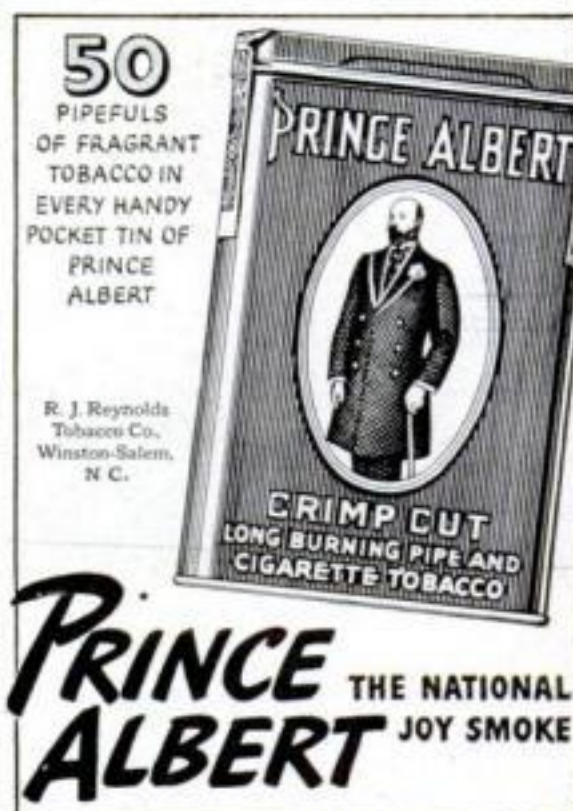
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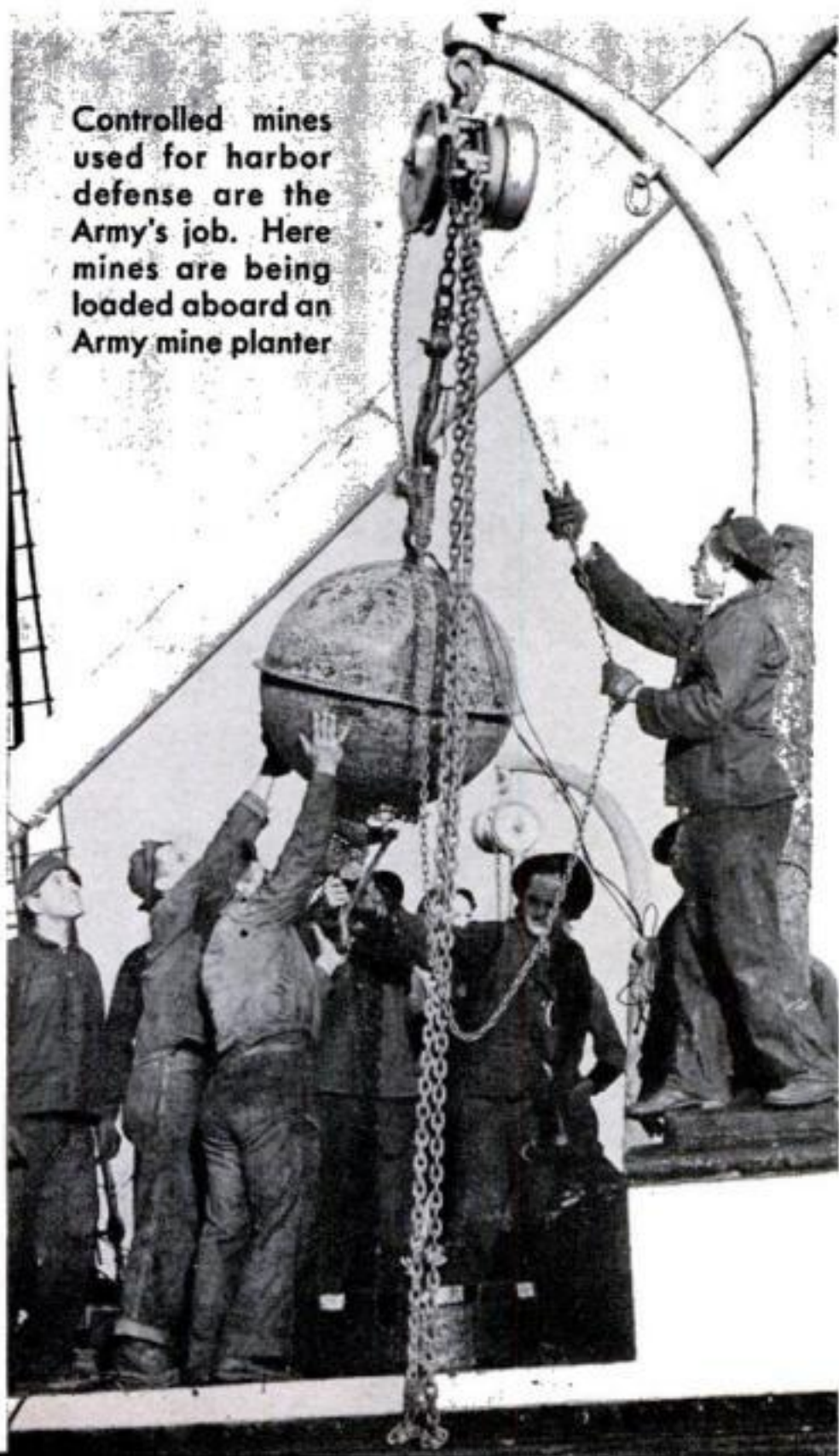
The U. S. S. Boxwood, one of the Navy's fleet of 160-foot boats detailed to lay and tend anti-submarine nets



Fighting the Submarine Menace

BARRIERS OF STEEL ACROSS OUR HARBOR ENTRANCES PROTECT SHIPS FROM TORPEDO ATTACK

Controlled mines used for harbor defense are the Army's job. Here mines are being loaded aboard an Army mine planter



HARBOR defense — guarding anchored and tied-up ships—constitutes one of the most important branches of military science today. It calls for anti-submarine nets and controlled mines, and such craft as are needed to lay and tend them. In each respect, vast improvements have been made since the last world war.

Harbor nets, often supplemented by natural obstacles and by blockships purposely sunk at suitable points, completely close the mouth of a port. Their floats support a mesh of heavy metal, extending all the way to the bottom and anchored or weighted sufficiently to prevent the entrance of an enemy submarine. Reportedly of as much as three-inch thickness, their close mesh stops both submarines and torpedoes. So that friendly vessels can enter and leave a port thus screened, a movable "gate" section of the net may be opened or closed at will.

The U. S. Navy already has developed special vessels designed from the keel up for the express purpose of handling harbor nets. If they have been turned out on schedule—war restrictions on launching announcements preclude more definite information—a fleet of from 70 to 90 or more

net boats should now be in service. They fall into three classes.

Most interesting of the new craft are the largest type—500-ton vessels intended for laying and repairing nets. From their overhanging bow gear to their rounded sterns, they have an overall length of about 160 feet. The class includes ships named after trees, such as the U. S. S. *Locust*, *Boxwood*, and *Gum Tree*. So as not to interfere with construction of seagoing men-of-war, many have been built at inland shipyards.

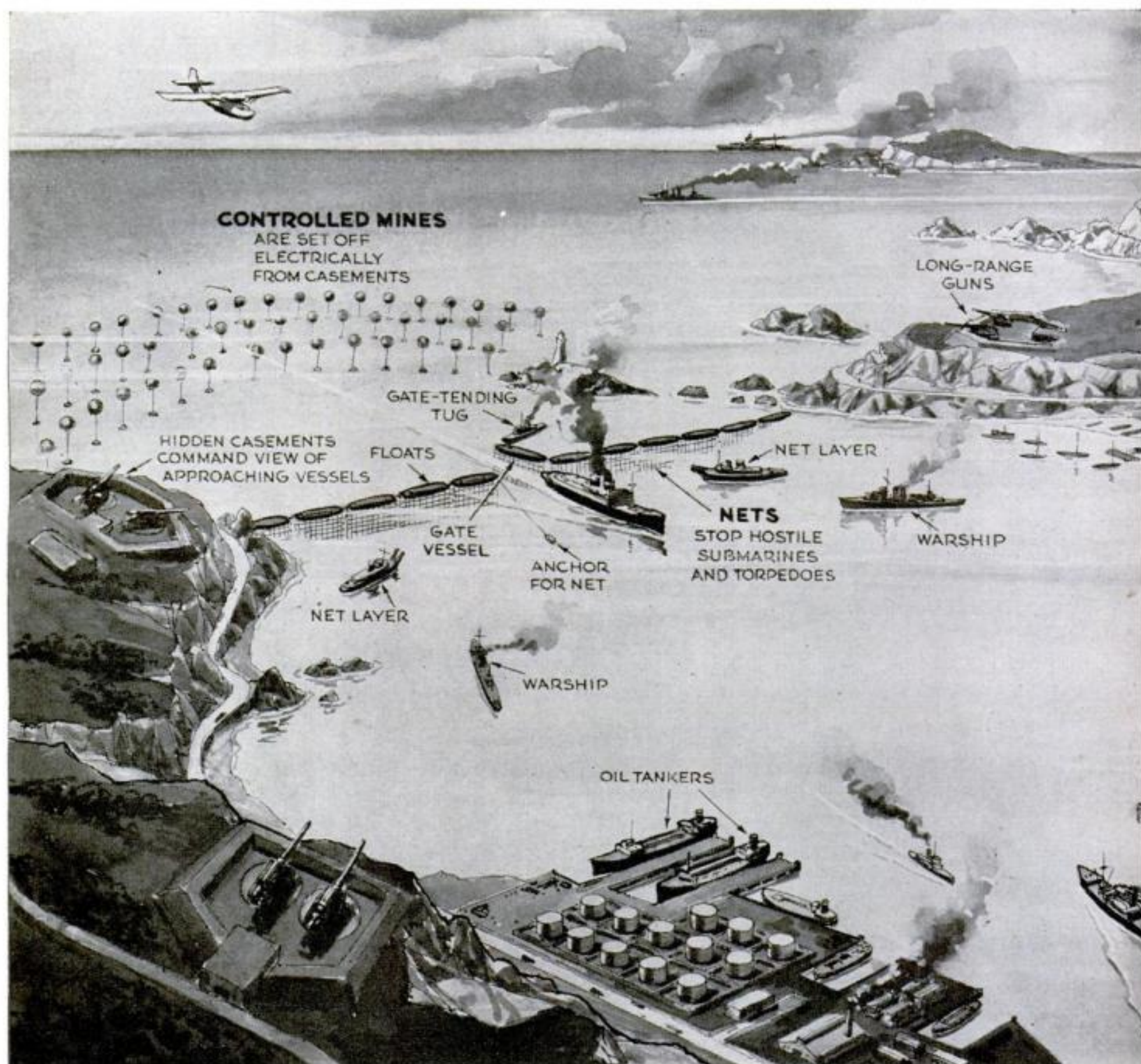
A second type of net vessel, resembling a barge but specially equipped for its service, acts as the gate of the net. A Pennsylvania shipbuilding and engineering firm has been filling Government orders for many of the 110-foot, motorless craft.

Net-tending tugs, the third class of boats, open and close the gates. They also, on oc-

casional, assist in net-laying operations. Many of these 70 to 100-foot wooden craft, it is reported, have been built for the Navy. Others have been purchased from tugboat operators and converted for Navy purposes, as has at least one purse seiner.

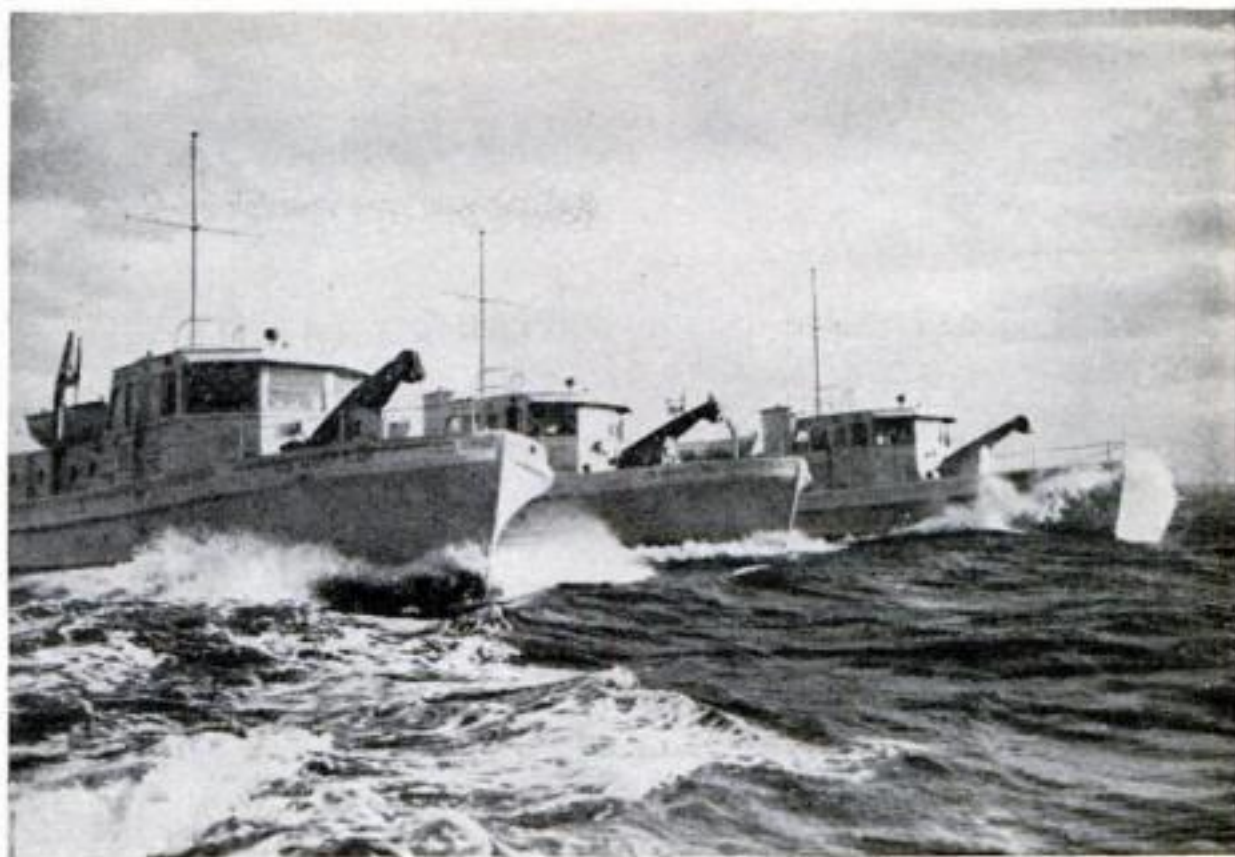
During the last world war, tugboats alone served as hastily improvised net-laying vessels, in contrast with the specialized ships now available. Likewise, gasoline drums and beer kegs have given way to large wooden floats, to support the nets.

No less advance has occurred in the art of laying the Army's controlled harbor mines. In contrast with "contact" mines, the Army mines distinguish between friend and foe. Moored in submerged rows, they are set off electrically by observers in hidden casemates ashore, just as an enemy vessel goes by. Telescopes spot the location of surface

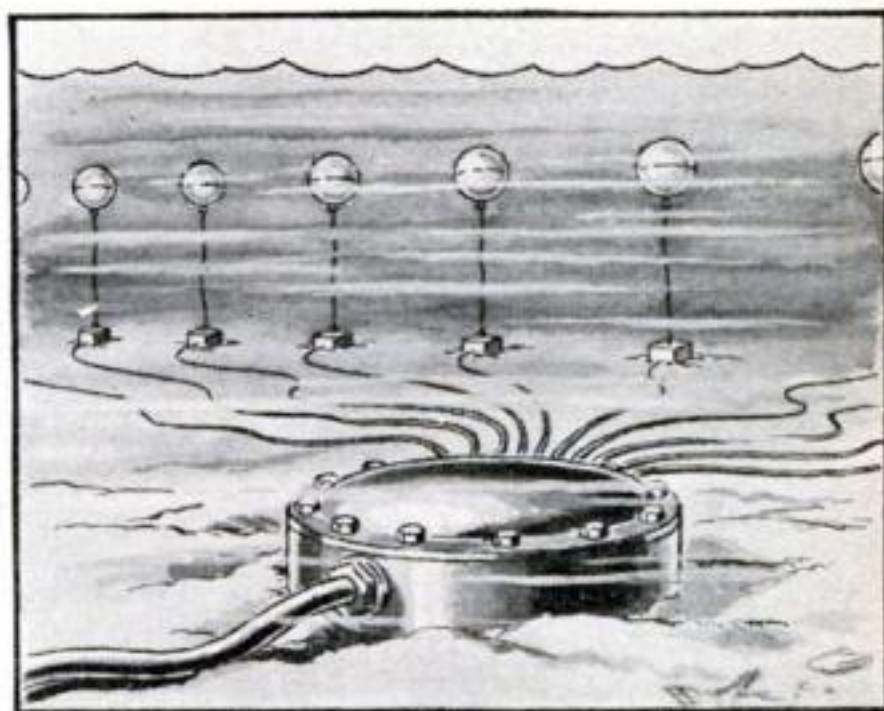
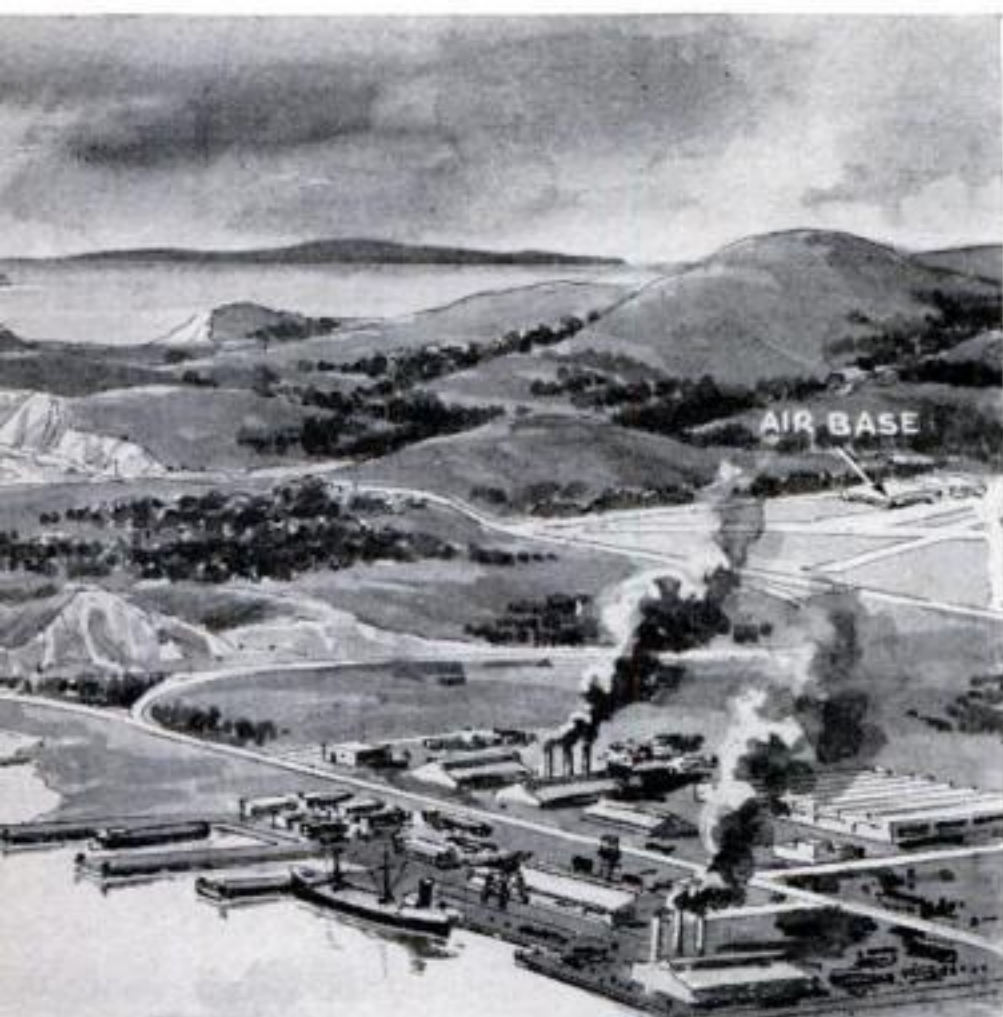


craft. But if a hostile submarine blunders into one of the mines, a bell immediately rings in the casemate.

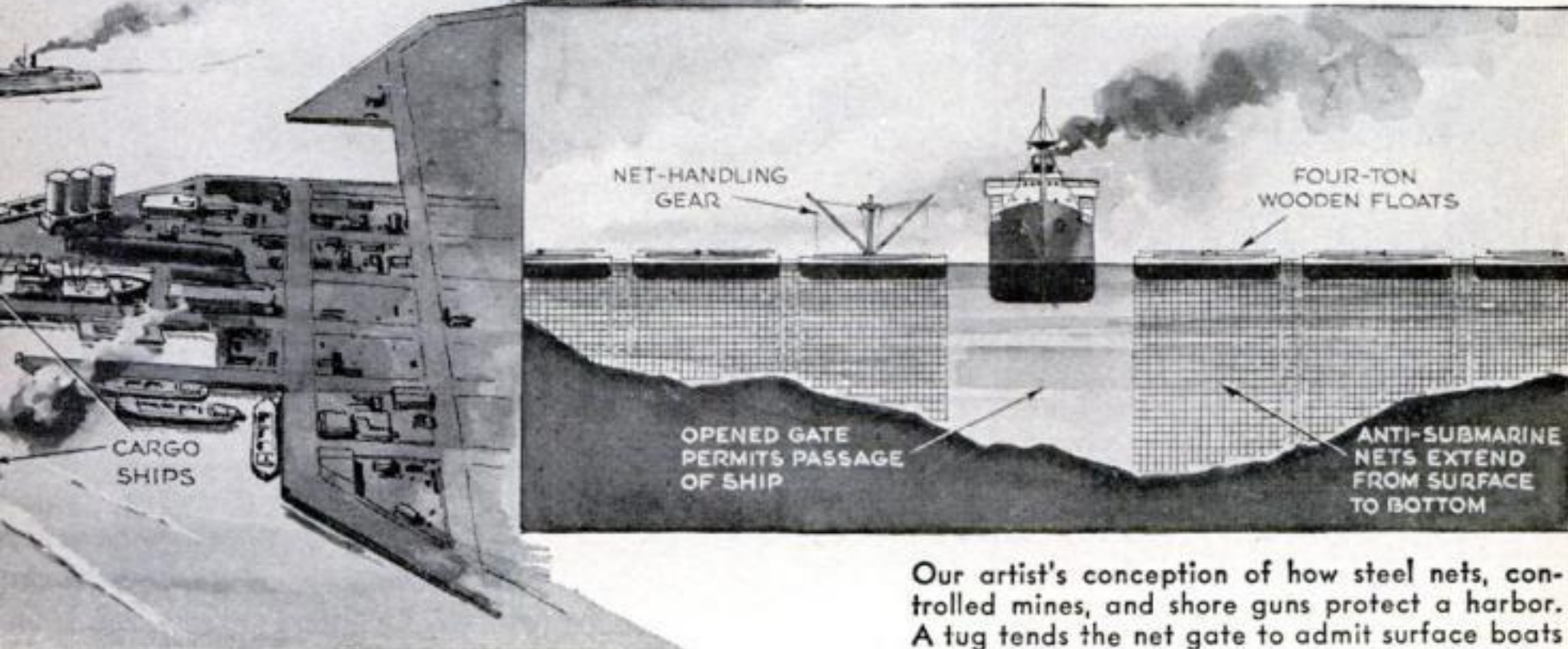
U. S. harbor protection by nets and mines is as vital as it is deemed strong. New kinds of nets have been developed, and new methods of net laying perfected, including ways to keep the unwieldy apparatus in position. And modern mine-planting crews can quickly transform a defenseless port into one that offers a deadly menace to hostile visitors.



These fast, Diesel "distribution-box" boats tend the electrical systems of harbor mine fields

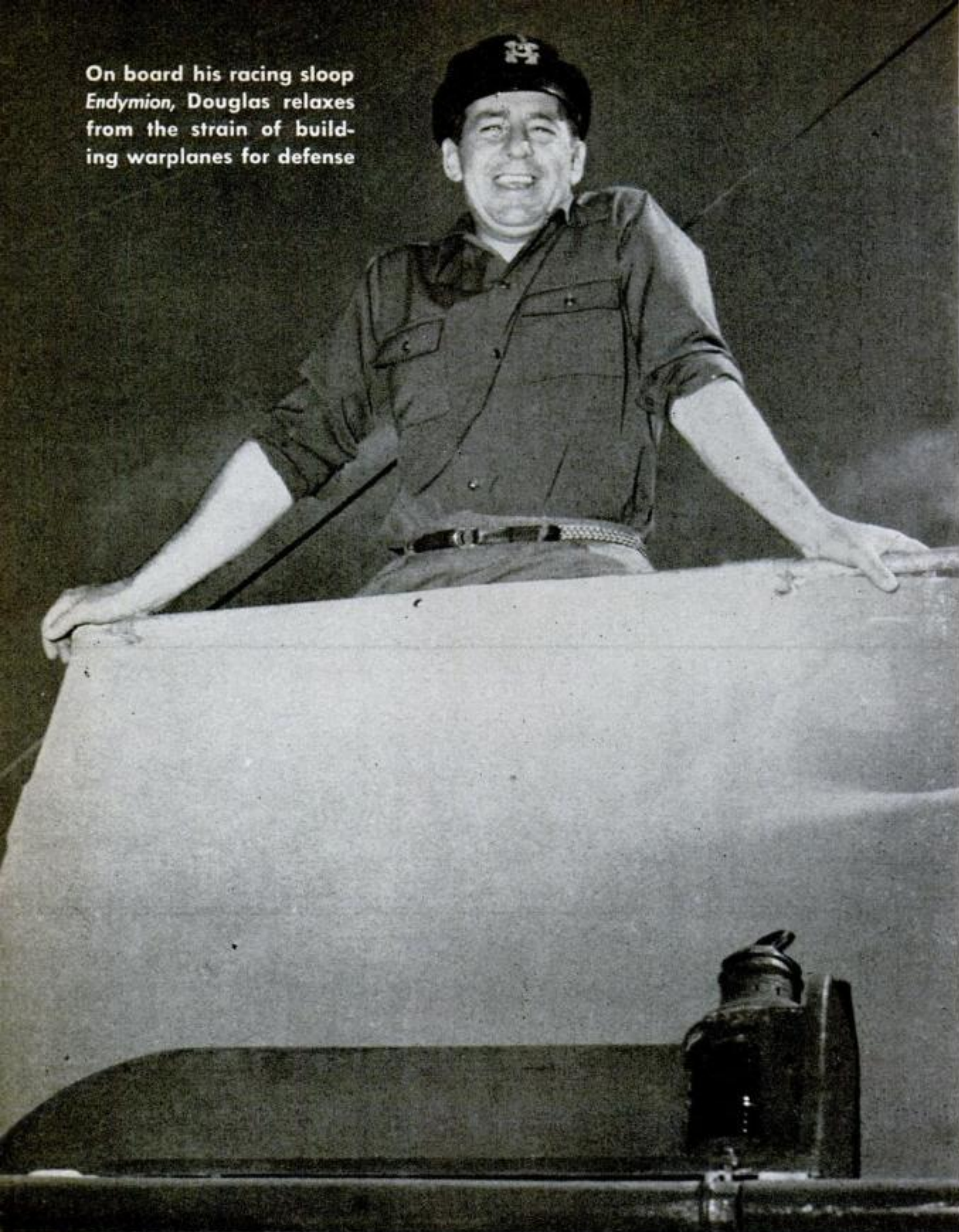


Harbor mines are controlled from shore. Electrical connections through distribution boxes allow mines to be set off by pushing switches



Our artist's conception of how steel nets, controlled mines, and shore guns protect a harbor. A tug tends the net gate to admit surface boats

On board his racing sloop
Endymion, Douglas relaxes
from the strain of build-
ing warplanes for defense



\$2,500,000 Worth of Planes a Day

DONALD DOUGLAS set that as a production goal in filling orders for \$654,579,973.26 in warplanes for America and her allies. And he is reaching that goal on schedule—just as he has always come through on every job that he has ever tackled

HE BUILT HIS ENGINEERING GENIUS INTO PLANES THAT ARE FIGHTING OUR ENEMIES ON LAND AND SEA

By **ANDREW R. BOONE**

ONE afternoon in the early summer of 1909, only six years after the Wright brothers were catapulted from Kill Devil Hill into the world's first heavier-than-air flight, a slender youth named Donald Wills Douglas hurried over from Washington to Fort Meyer, Va., to catch his first glimpse of an airplane. For an hour, the famous brothers tossed wisps of dust up to test the breeze. At last they roared out over the corral, their chattering engine and beating propeller frightening men and horses.

Chance got the wide-eyed youth his opportunity to be in near the birth of aviation. He had received an appointment to the U. S. Naval Academy, subject to a bit of surgery, and had gone to Washington a few days earlier to enter a hospital. A few weeks after observing the demonstration, he became a plebe, and celebrated by launching from a dormitory window a model plane put together by his own hands. The plane promptly smacked into an admiral's cap as that officer strolled along a walkway outside.

Thirty-two years later, the same Donald Douglas on an early summer afternoon walked diffidently from a hangar at Clover Field, near Santa Monica, Calif., heard four powerful engines ticking methodically on the largest airplane ever built. The great bird was the B-19, a bomber capable of carrying a huge load of bombs across an ocean and returning home again. For miles in all directions, 100,000 people jammed the highways for a glimpse of another his-

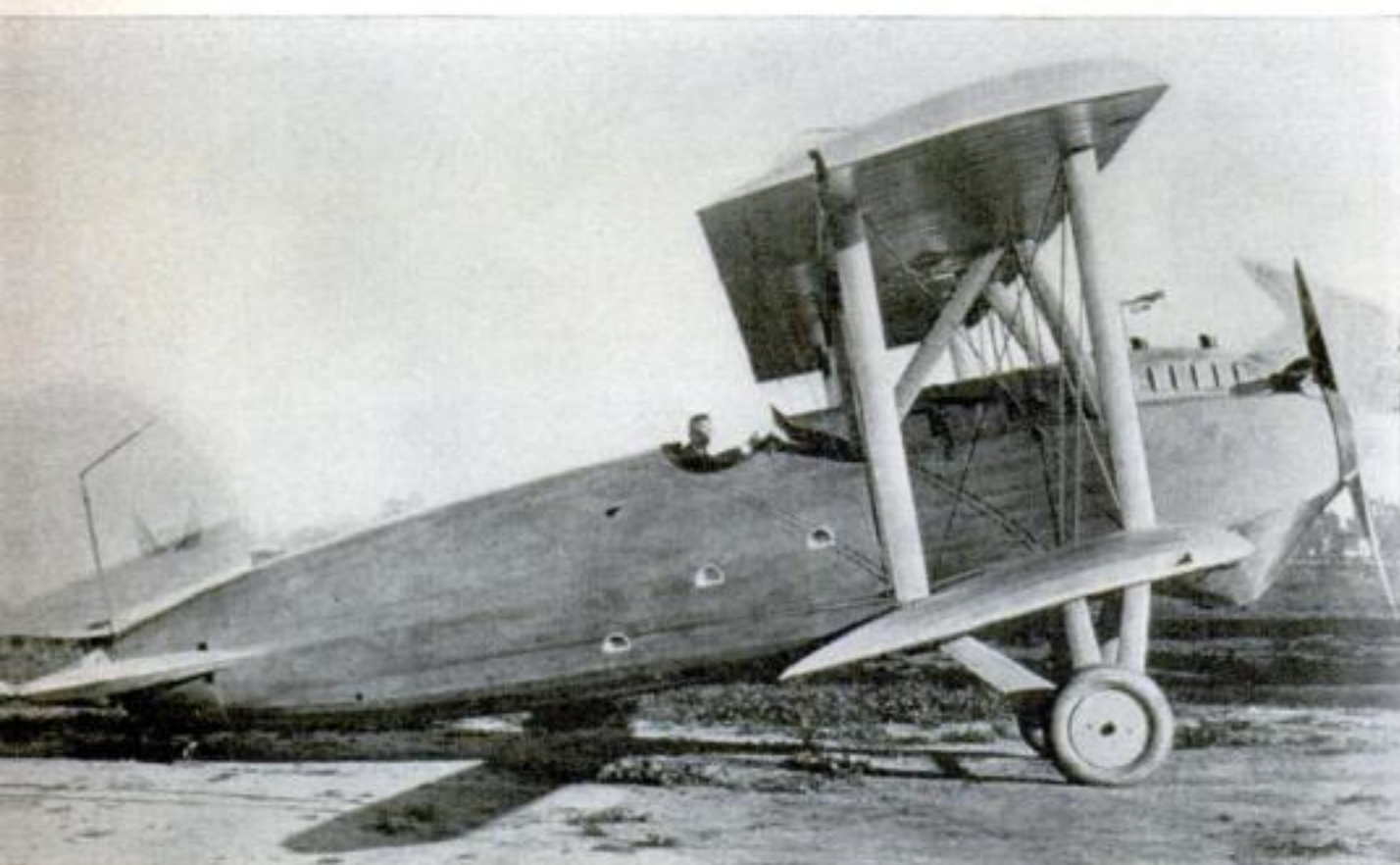
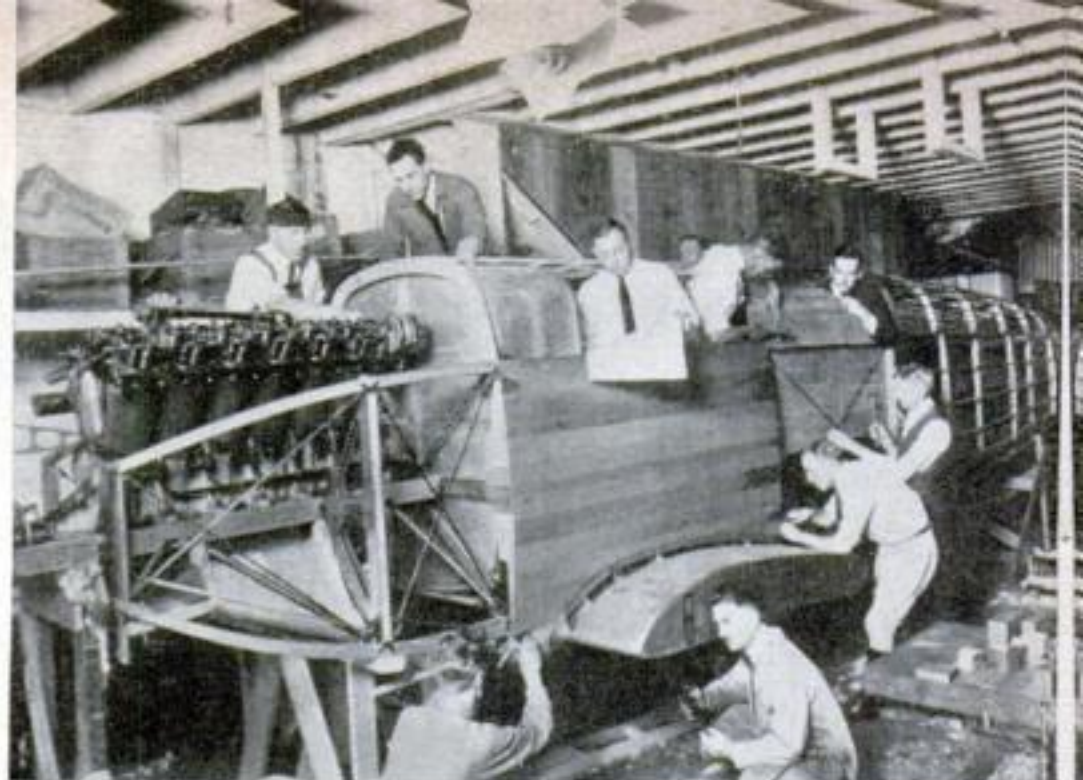
toric flight. Shortly, the pilot gunned the engines, and the B-19 soared into the sky.

Between Fort Meyer and Clover Field, Donald Douglas in three decades has achieved world eminence in aviation. From the time he set out to build an airplane, in 1921, until today he has never experienced failure. His passenger liners span the nation on 17 airlines, serve 52 foreign countries on another 18 lines; cargo and troop carriers, dive bombers, medium bombers, and huge four-engine bombers from his factories are fighting for Uncle Sam and his allies. Every day a million dollars' worth of new airplanes roll from his assembly lines.

Although his designs have revolutionized commercial aviation and added mightily to our aerial defense, Douglas has everlastingly avoided the spotlight. He'd rather lose a tooth to the dentist's forceps than make a

Latest triumph of Douglas design is the B-19, world's biggest plane. This striking view shows one of the outboard engines and one of the mammoth landing wheels



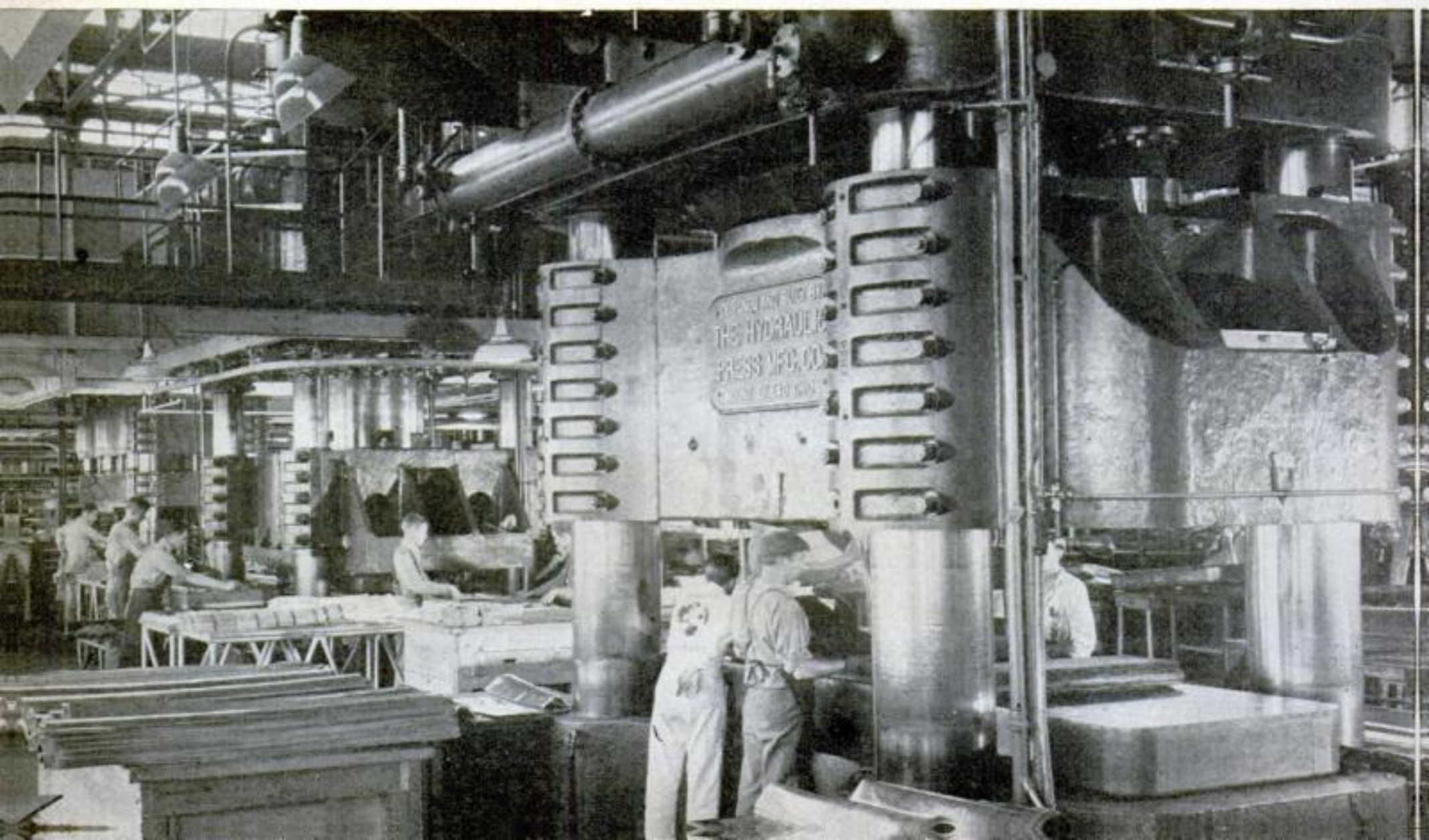


Beginnings: At upper left is the Los Angeles barber-shop office of Douglas and his early partner, David R. Davis. It was here that he designed his first plane

... the Cloudster, pictured above as it took shape in a Los Angeles warehouse. Streamlined and equipped with instruments, it was a reconnaissance-type craft

This is the finished Cloudster. Though it failed in an attempted nonstop transcontinental flight in 1921, it served as the pattern for a Navy torpedo plane

Today, Douglas plants cover 3,338,100 square feet of floor space, by next June will reach 5,000,000. This is a scene in one of the mammoth factories that are turning out a steady stream of planes night and day



speech. Bronzed by frequent week-ends off the California coast on his racing sloop, he spends long days at a large desk in a small office where he devotes his engineering and business genius to planning new planes to fight our enemies.

As an engineer, he has won the coveted Collier and Guggenheim awards. From the business angle, his enterprises have shown a profit ever since he became a builder of airplanes 20 years ago, from the two-place Cloudster, a biplane which introduced new techniques in streamlining, to his A-24 dive bomber, so good that Army authorities declared two squadrons "out-Stukaed the German Stukas" in the recent large-scale war games down in Louisiana.

Douglas is a "pilot's designer." Above and beyond his engineering skill, however, you find a single-mindedness rare in manufacturers. When he left the Naval Academy in 1912, his mind was focused on wings and skies. That autumn he enrolled in the Massachusetts Institute of Technology, graduating two years later and receiving immediately a year's appointment as assistant in aeronautical engineering. Salary, \$500 per annum.

Young Douglas moved rapidly during the next few years. At M. I. T. he helped build the first wind tunnel. Next year found him at the Connecticut Aircraft Co., building the first dirigible constructed in the United States, the D-1. Shortly Glenn L. Martin brought him to his firm as chief engineer, and young Douglas' skill entered into the design of the famous twin-engine Martin bomber, a landmark in military aviation.

Now only 25, he already had won national recognition. Another jump landed him in Los Angeles, "approximately broke" but blessed with boundless confidence in his ability. On the West Coast Douglas met a wealthy young man named David R. Davis, who owned a small machine shop and wanted to get into aviation. Douglas sold Davis on the idea of building a reconnaissance-type plane, streamlined and equipped with instruments. A few months later

the Cloudster, conceived on drawing boards hugging the wall of a small barber shop, was perfected.

I talked to Eric Springer, test pilot for Douglas and Davis when the Cloudster was born and today manager of the El Segundo plant, building A-24's for the Army and their counterpart, the SBD, for the Navy and Marine Corps.

"Doug knew where he was headed then, and he's never given us a chance to forget. You can think of the Cloudster, or any of the 150-odd models since, as a cocktail. It's got to have the right proportion of all ingredients before it's served to a customer.

"Every Douglas ship," Springer continued, "represents a compromise. Not the fastest, maybe, nor the highest-flying, nor will it carry the heaviest load possible. But it'll be a pilot's airplane, combining speed, economy, and loadability."

Springer and Davis took off from March Field, the Army flying base in Southern California, early on the morning of June 25, 1921, hoping to make the first transcontinental nonstop flight. They reached El Paso ahead of schedule, when one bank of the timing gears failed just as they roared over Fort Bliss. Springer slid down to a dead-stick landing, and the attempt was written off as a failure when Lieutenants Kelly and Macready made the flight in a single-engine Fokker monoplane a short time later.

The failure was only apparent, however, for the Navy shortly requested specifications for a torpedo plane, inviting both American and European companies to participate. The ship was to fly from pon-



From his quiet office, Douglas looks into a future in which he foresees a vast market for commercial planes to take the place of ships and other transport facilities destroyed in the war

tons, and be powered with a 400-horsepower Liberty engine. From the data perfected in building the Cloudster, Douglas turned out the winning design, of which the Navy bought 61 copies. This led to development of a new series with which U. S. Army officers in 1924 succeeded in flying 25,000 miles around the world.

In 1932 the airlines, just crawling up from the depression, faced the necessity of increasing their speed, providing greater comfort for day passengers and beds for those flying at night, and cutting operating costs.

Early in 1933, TWA officials decided speed must be upped 50 miles an hour, that other characteristics of safety and power must be provided. Douglas and four other manufac-

turers received requests for bids, one requirement being that the plane accepted must be able to fly from any regular airport in the country on one engine, proceed to the next scheduled stop, and have a legal reserve of gas remaining in the tanks on arrival. TWA awarded the contract to Douglas, and a new era in American air transport began.

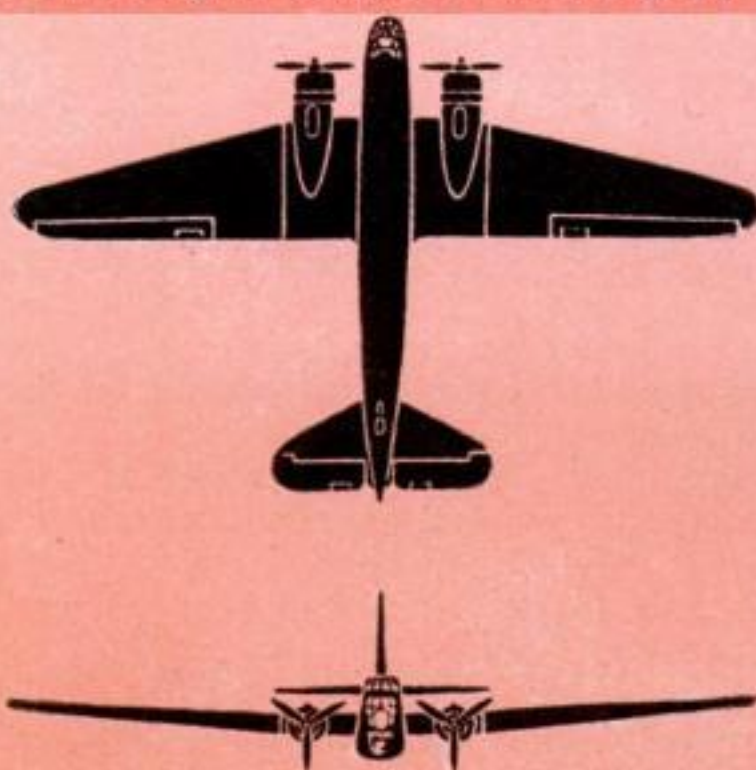
Douglas built the DC-1 for peacetime flying. The ship upped cruising speed from 100 miles an hour to 150. With a few changes, the production model became the DC-2. Shortly, improvements were incorporated in a third model, the DC-3. Whereas 186 DC-2's were built, more than 1,500 DC-3's will have been constructed by early next year for the air lines, and for the U. S. Army for employ-

DOUGLAS MILITARY PLANES

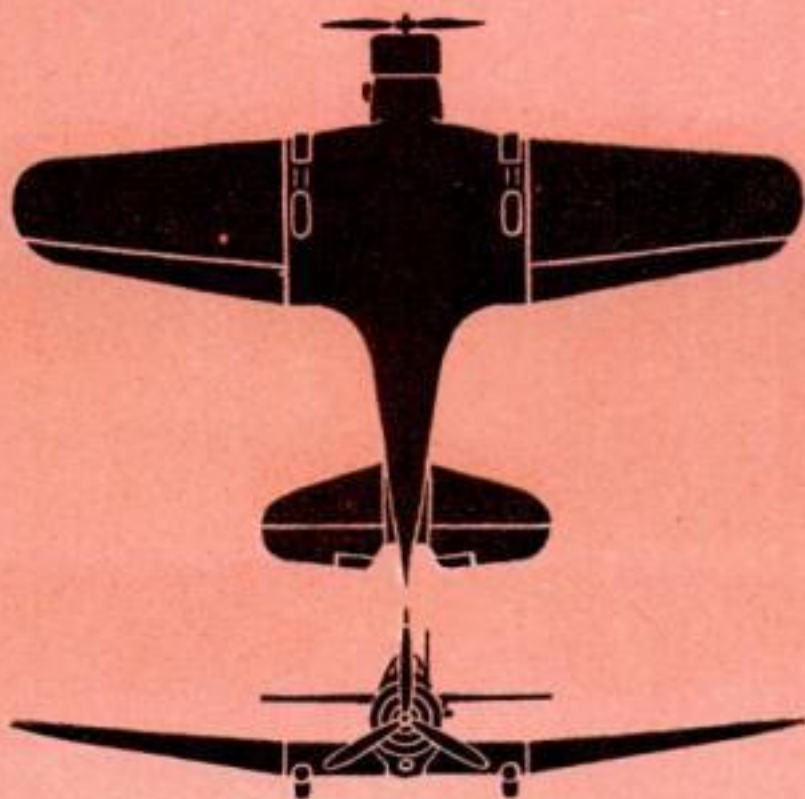
U. S. ARMY B-19
Four-Engine Bomber



U. S. ARMY B-18A
Two-Engine Bomber (British Digby)



U. S. NAVY TBD
Torpedo Plane (Devastator)



U. S. ARMY O-46
Observation



ment as troop and military cargo carriers.

The DC-3 series gave world travelers their first taste of real flying comfort, and as they drew increasing numbers of passengers into the air, brought the lines out of the red. Today these 25,200-pound planes, after five years without a major structural change, are still standard equipment.

Sitting at the hub of a large engineering and manufacturing organization, Douglas can't poke his finger into every detail, but he guides the preliminary design of any new ship, whether transport or bomber. He leaves details to his experts.

Seated in the quiet of his paneled office, we might have been a thousand miles from the clatter of riveting and roaring of test

engines just beyond the soundproof walls when I asked him to look into the future.

"Let's start with invisible bombing," I said. "How high will the bombers fly?"

"Some of our plans must remain military secrets," he warned, "but I can go this far: Recently we have completed a 'cold room,' where the thermometer drops down to about 105 degrees below zero. In that room we're testing oxygen apparatus, paints which we hope will not chip and flake in extreme cold, metals, and men." The "cold room," whose temperatures fall below those flyers experience at the highest levels any plane today can reach, is the laboratory where he's getting ready for stratospheric bombing.

Douglas considers the fabulous B-19 to

AND HOW TO RECOGNIZE THEM

U. S. ARMY A-20
Attack Bomber (British Boston, Havoc)



U. S. ARMY A-24, NAVY SBD
Scout-Dive Bomber (Dauntless)

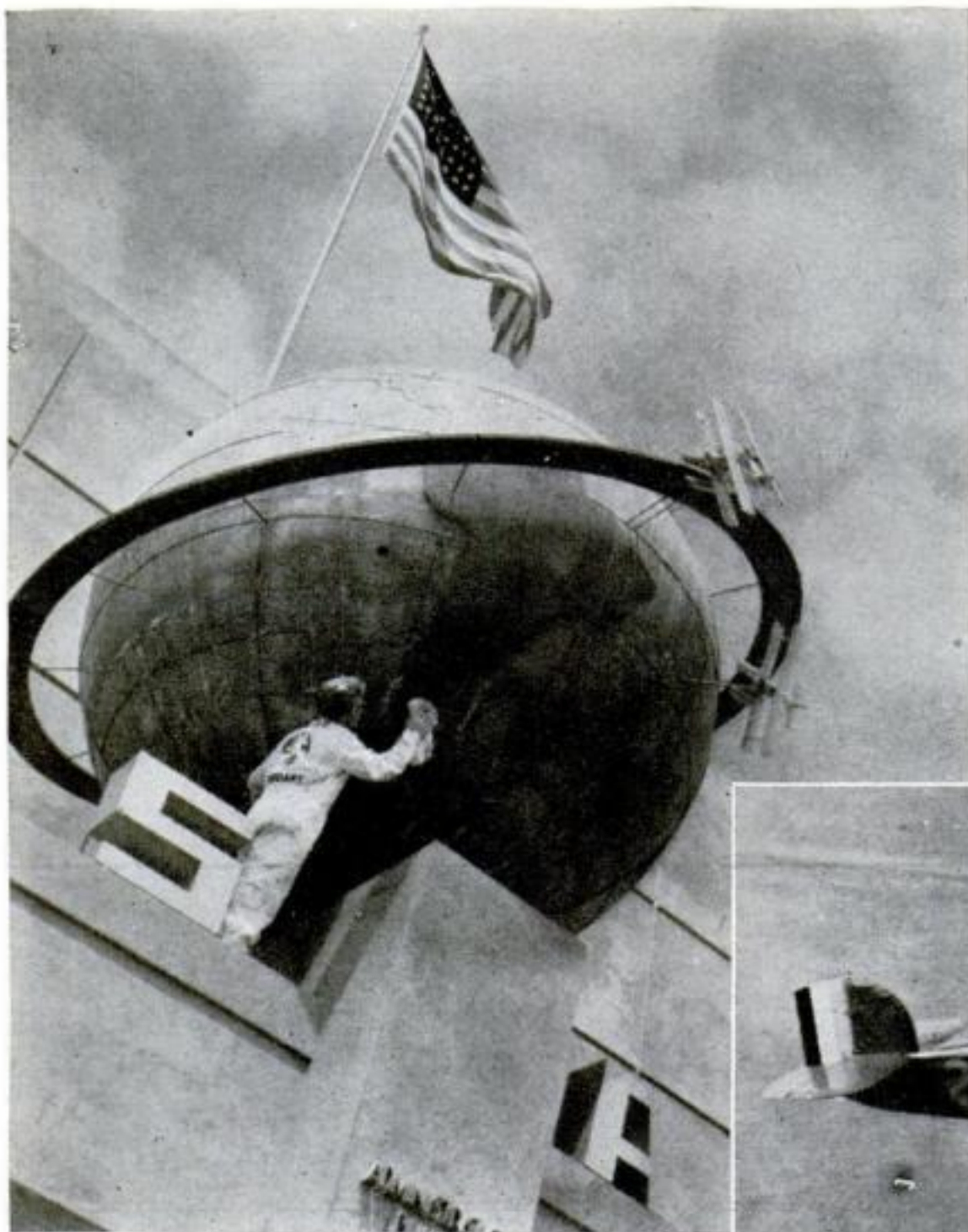


U. S. ARMY C-39
(Commercial DC-2) Transport and Cargo (Commercial DC-3)

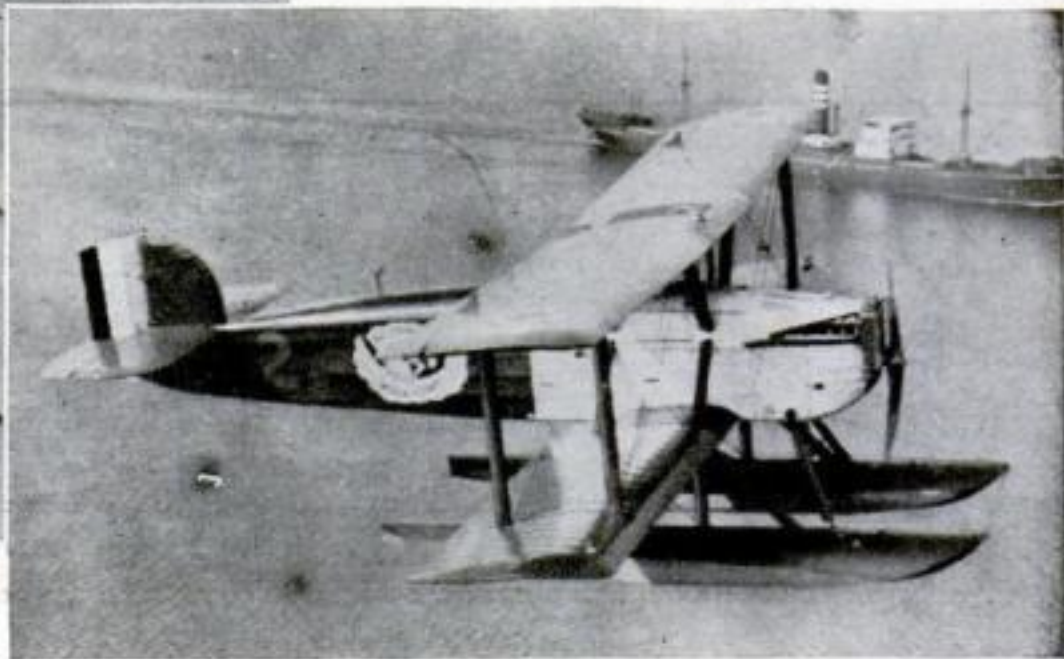


U. S. ARMY C-47, C-48, C-49
(Commercial DC-3) Transport and Cargo (Commercial DC-3)





This emblem on the administration building of the new Douglas black-out plant at Long Beach, Calif., symbolizes one of his greatest triumphs, the 25,000-mile round-the-world flight made by U. S. Army airmen in 1924 in two Douglas planes. That achievement was the cause of the city of Santa Monica giving him the ground for his present No. 1 plant. Below, one of the globe-girdling planes passing a steamer in the Pacific on the first leg of the flight



be the guidepost which may usher in an era of superbombers of which no more than a half dozen fighting airmen dared dream as recently as a year ago.

"Suppose," he said, "we're asked to jump from our 30-ton bombers to a machine of 200,000 pounds. The big fellow might fail unless we know where we're heading. The B-19 gives us fine supporting evidence on which to build a 100-ton bomber. She is a point from which we may embark on designs for planes capable of carrying much heavier bomb loads out of sight in the stratosphere for long distances."

But Douglas also has his eyes fixed on the needs of peace. He sees, first, shipyards taxed to capacity turning out freighters. For several years, in his opinion, few passenger liners will be built. This leaves an opportunity for a tremendous aviation construction program.

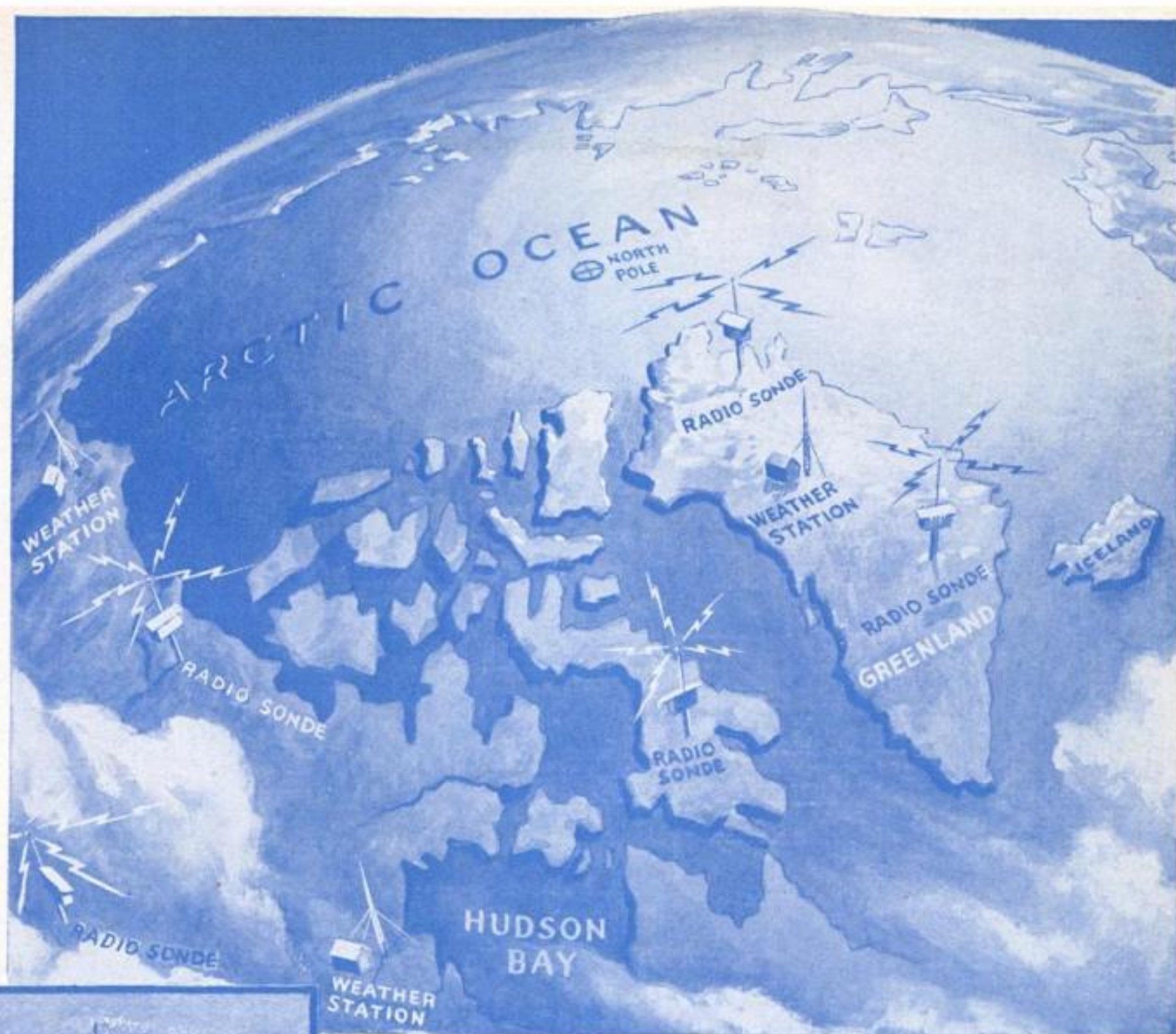
"Low fares," he suggested, "should open up tremendous ocean trade for both passengers and freight. Trans-oceanic flying is receiving its impetus now, and the long-range bombers will furnish the designs

from which we may turn our assembly lines to long-range seagoing land planes."

Engineer, salesman, executive, financier—Douglas is all these. But first he is a builder. From his El Segundo assembly line attack bombers, A-24 and SBD, move on to the Army and Navy. The Santa Monica factory assembles DB-7 Havocs for the British and A-20's for Uncle Sam (similar to but better than Havocs), plus Army troop-cargo carriers. The new blackout plant at Long Beach turns out more troop-cargo ships, and mighty B-17E bombers developed by Boeing for the Army Air Corps.

Soon after the newest plant at Tulsa, Okla., was dedicated in October, Consolidated B-24 bombers, fabricated and subassembled by the Ford Motor Company, were taking wing.

Today Douglas employs 32,000 men and women. By June there will be 75,000 persons on his payroll, working in plants spread over 5,000,000 square feet. As I write, armies and navies, with such civilian customers as priorities permit, have swamped him with a backlog of \$654,579,973.26, enough to keep him going at top speed for many months.



Network of Robot Radio Stations To Give Arctic Weather Data

ROBOT radio stations, scattered across the top of the earth, will automatically transmit such information as temperature, humidity, barometric pressure, and wind velocity, with the fruition of U. S. Weather Bureau plans. The automatic posts in the Arctic, where our weather is said to begin, will aid forecasters to anticipate conditions in milder climes.

Now in the early stages of experimental development, the "radio sonde" transmitter will be a land adaptation of similar devices currently carried aloft by balloons, and will operate in conjunction with them. For terrestrial use, it will be sheathed in metal and mounted on a post. Each of the instruments is so arranged that its reading will affect the resistance of an electrical circuit, and, in turn, the signals periodically broadcast over a range of 100 miles by the self-operating transmitter. The equipment requires only infrequent servicing, which probably will be done by airplanes. A central weather station on land or on an ocean-going cutter picks up the reports from the outposts, which are translated into marks on a moving sheet of paper by the recording receiver. Another use foreseen for the radio equipment would be in predicting river stages of streams which flood rapidly, and whose upper reaches are uninhabited.

How weather reports from unattended radio-sonde outposts scattered through the Arctic will be picked up by weather stations. The inset shows the appearance of one of the transmitters

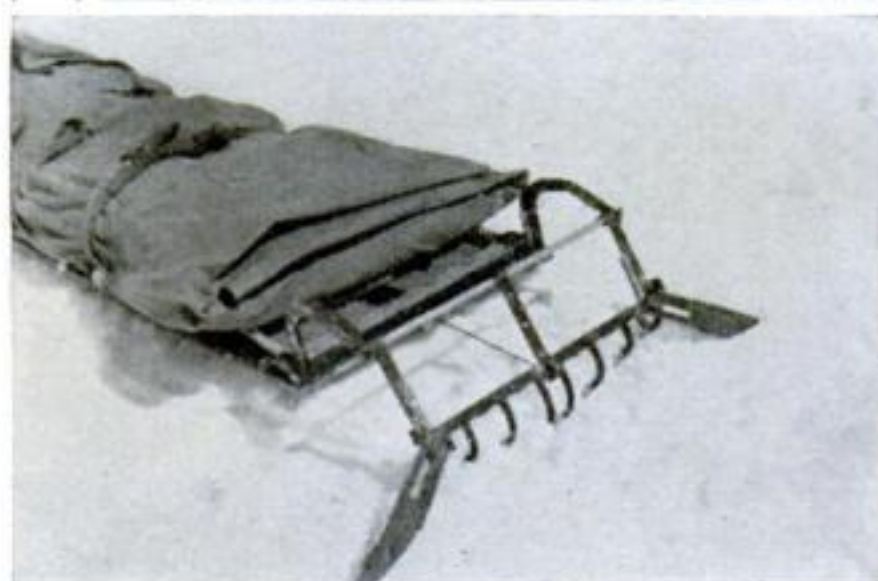


A sliding ambulance for skiers: a ranger straddles a bar and guides the sled down a slope by handlebars

It even has a brake. A lever on the handlebar operates a cable to pull down a rake-like apparatus at the rear, as shown below. For descending a uniform slope, the brake tension can be set to leave both hands free

Rescue Sled for Skiers Is Handled by One Man

FOREST RANGERS in California's Yosemite National Park are using a recently developed rescue sled to bring in skiers injured on the snow-covered slopes. Infinitely superior to the old toboggans which required four men to handle and strained ranger personnel, this sled is light and maneuverable enough for one man on skis to operate. The key to the efficiency of the new device is a rake-like apparatus on the back of the sled, which acts as a brake on downhill runs. From the handlebar, with which the ranger pulls the sled, a cable runs to the brake. While it may be operated by a lever on the handlebar, the brake may also be set at any desired tension, so that in coming down a uniform slope speed may be regulated without the use of hands, leaving them free to steer the sled. Yosemite rangers spent three winters perfecting the new sled, with which they expect to be able to cope with the ever-increasing number of accident calls during the skiing season.



Refrigerated Trucks Deliver Frozen Foods

FROZEN FOODS today are being delivered straight to the housewife in refrigerated motor trucks. Mounted on either side of the new trucks are compartments containing freezing cylinders, in which subzero temperatures are maintained by two gasoline-powered compressors. Refrigerated trucks capable of long-distance hauls as well as those of shorter wheelbase for door-to-door delivery are in use.

"Toasting" Old Records

TO SAVE THEM



LIMEWATER BATH removes discolorations and loosens dust and grease from valuable documents to be preserved by the Barrow laminating process

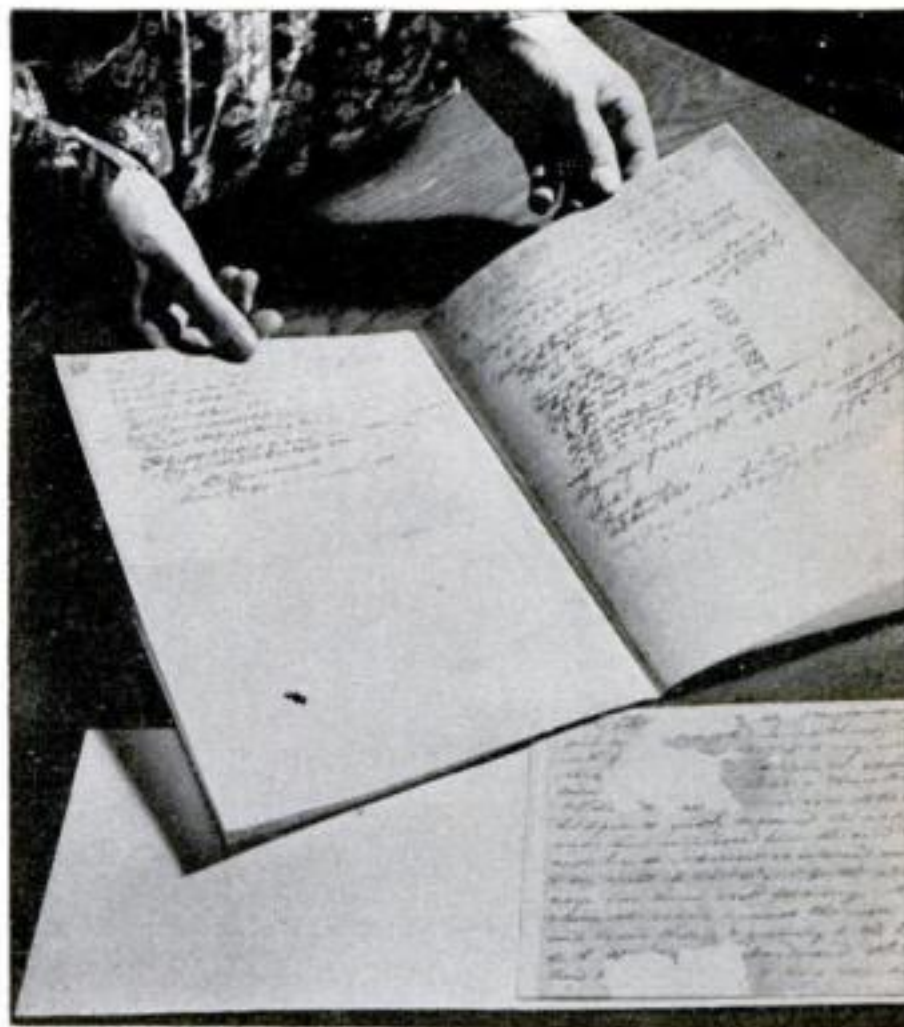


DRYING in the air on metal racks is followed by sandwiching the papers between very thin sheets of cellulose-acetate foil and covering with a tissue

"TOASTING" in the laminator at a temperature of about 315 degrees F. softens the acetate foil, and rollers weld tissue, foil, and paper into one



PRICELESS old documents, which time and neglect have rendered almost unreadable, can be restored and preserved indefinitely by a new process. First, the paper is given a limewater bath which removes discoloration and loosens dust and grease. Next, it is washed in a calcium carbonate solution and placed on a metal rack to dry. It is then put between two sheets of extremely thin cellulose acetate foil and covered by purified tissue a thousandth of an inch thick. Two pieces of tracing cloth are put on each side and the whole goes into a "laminator" which acts as a combination toaster and wringer. The toaster heats the covered document to a temperature of 315 degrees F. This softens the acetate foil to plastic consistency, and the sheet is put through two rollers which exert a pressure of 1,000 pounds to the square inch. The acetate foil, the tissue, and the original document fuse together and the document is permanently preserved in a dust-free, easily legible condition.



THE RESULT is to preserve the document indefinitely, eliminate all dust, and make it more legible by removing the discolorations it contained. No glossy, artificial finish is added by treatment

Gasoline



From here to the front. New Army five-gallon gas cans fill quickly and stack easily on fast trucks

Tanks and Trucks Won't Run Without Fuel. Here Is How Our Soldiers Feed the Thirsty Mouths of Mechanized War

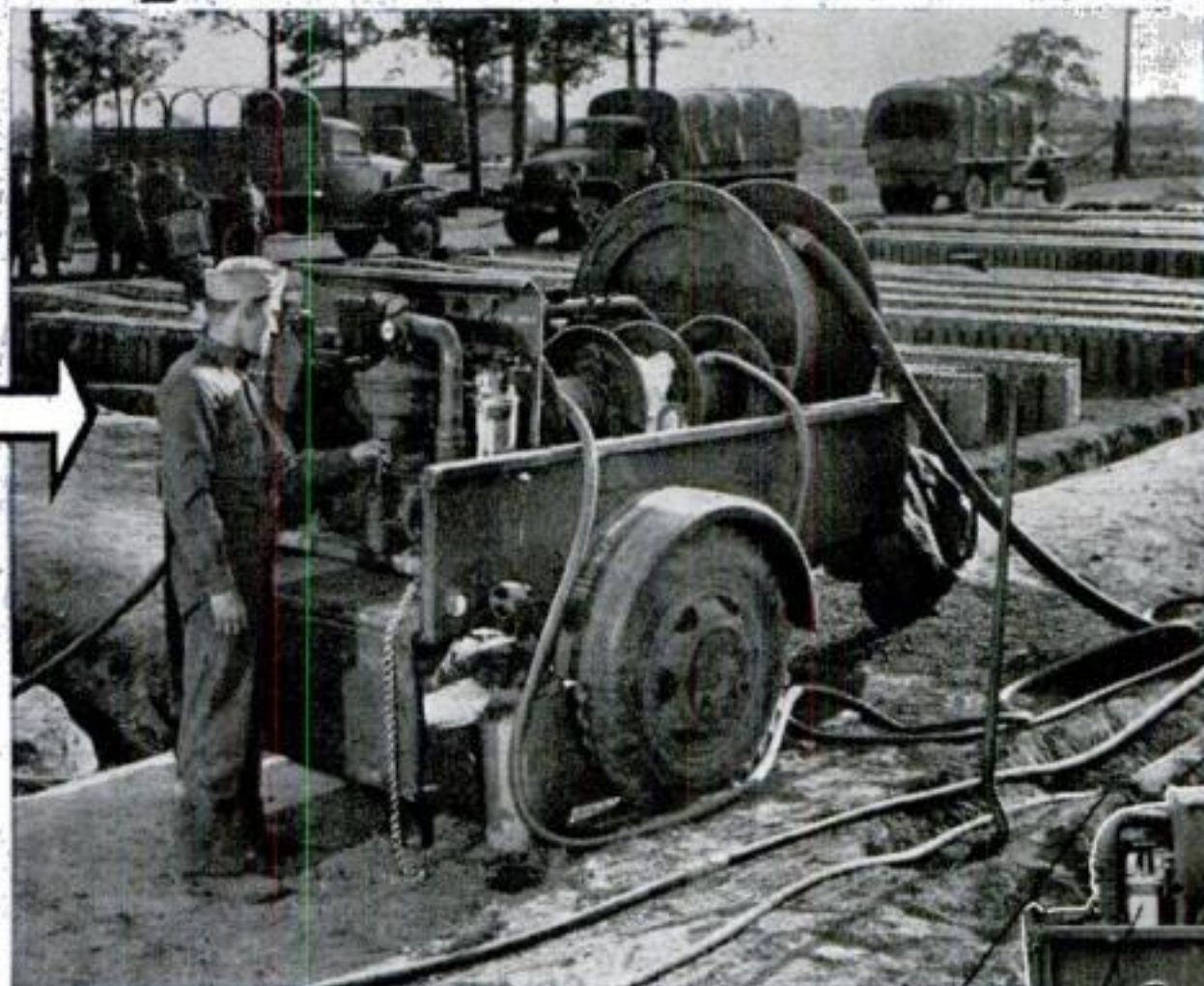
By HICKMAN POWELL

NAPOLEON'S army traveled on its stomach. Gunga Din's army fought on water. But in the modern army both of these prime necessities take a secondary position. Soldiers can go through hours, perhaps even days, of action without eating or drinking. But let a mechanized column run out of gasoline and it stops dead.

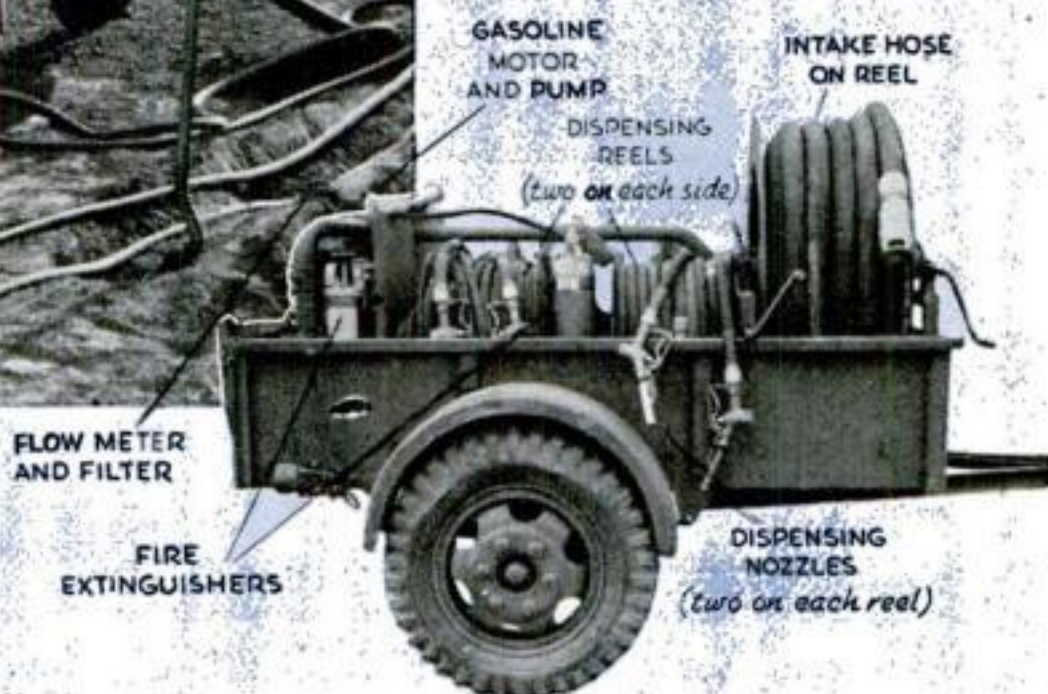
The Second Armored Division used 92,000 gallons in one night's fueling in the Carolina maneuvers. A single light tank loads up 54 gallons at a time in its fuel tank. And a mechanized army comprises thousands upon thousands of motor vehicles—all with a healthy thirst for gasoline.

Dispensing fuel to this myriad of units and their even more active supply columns, under the constant search of enemy observers and bombers, is one of the United States Army's most intricate problems. The big job lies in the dispensing of small quantities from the base source, which may be

for the Army



A filling station on wheels, this trailer dispenser will fill 500 gasoline cans in 30 minutes, enough to load four 2½-ton trucks. A pump draws from a tank car 90 feet away. Luminous dials help at night



large tank trucks, railroad tank cars, or a seagoing tanker.

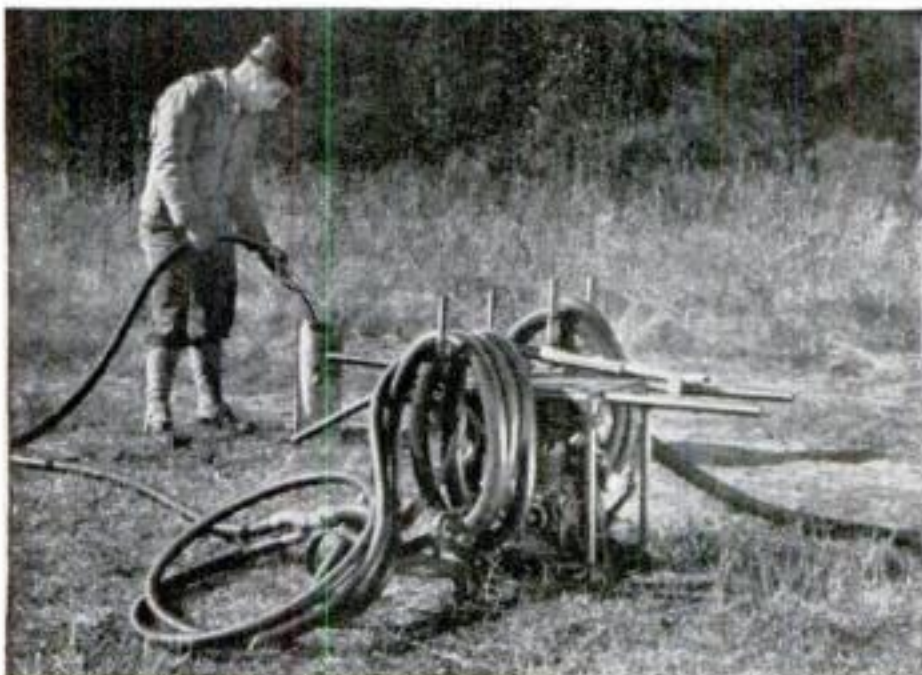
The final unit of supply ordinarily is the now familiar five-gallon can recently adopted by the Army. A 2½-ton cargo truck will neatly hold 125 of these cans, and make

a load light enough to be trundled over rough terrain. Small tank trucks, with 750-gallon capacity, also have been developed for cross-country use.

To get the gasoline quickly and efficiently into the cans the Army adopted a mobile

This dispenser, still experimental, can be carried by two men. Pipe frame supports light gasoline pump

Rectangular instead of round, the cans stack in speedy cross-country trucks without waste space



dispensing device consisting of a suction pump and five hose reels on a two-wheel trailer. Drawing up within 90 feet of a tank car, the dispenser runs a 100-foot suction hose into the tank. Four one-inch discharge hoses, 100 feet long, radiate from the pump, each ending in a fork with two nozzles. Thus within a 100-foot radius, four

dumps can be operated, the cans arranged in squares with fire-retarding trenches around them. At top efficiency this outfit can fill hundreds of cans in an hour.

Obviously such a layout would present an attractive bombing target by daylight and could operate satisfactorily in an active sector only in the dark. For this purpose

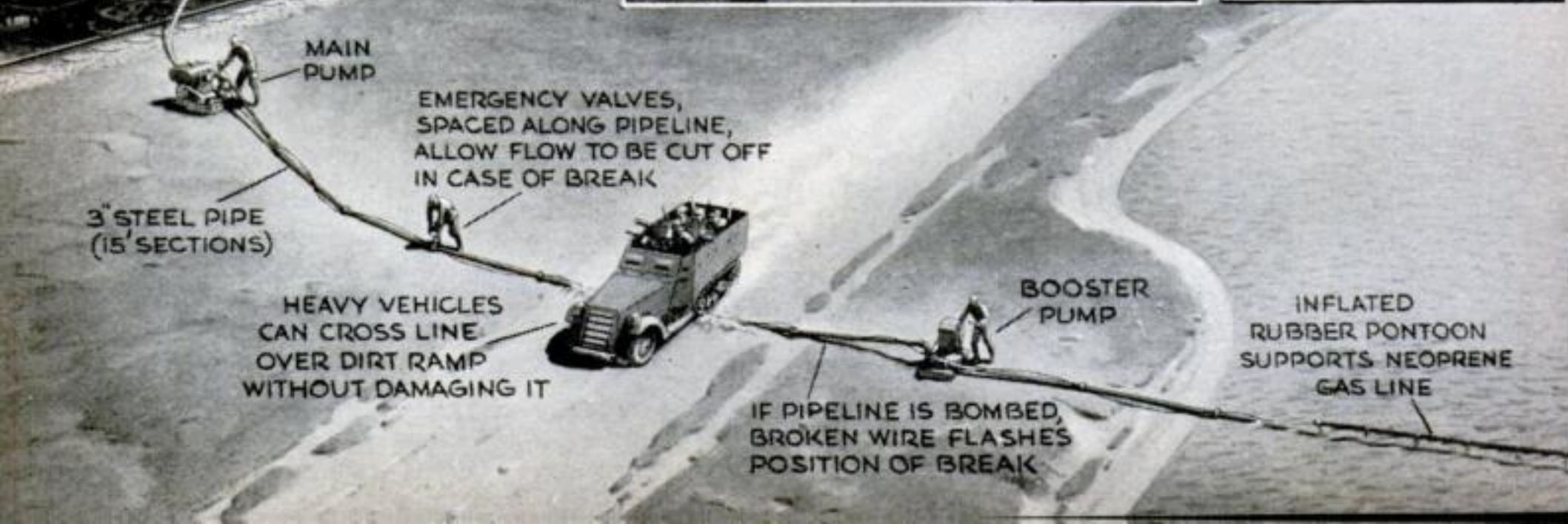
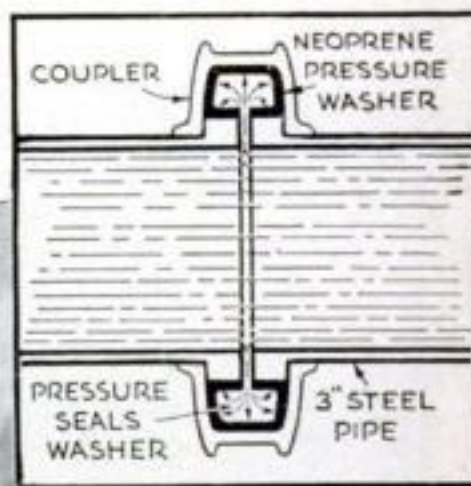
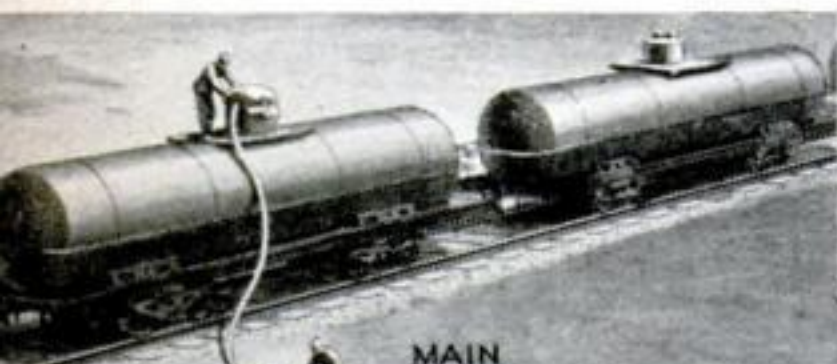


Out of a tank car, into a portable pipe line—this is the experiment tried in the Carolina maneuvers for hurrying gas over exposed country



The basic unit of the experimental pipe line is a 15-foot section weighing 48 pounds, light enough for one man to handle, strong enough to withstand heavy jolts. A 2½-ton truck carries 100 sections

Coupling is accomplished in one operation with a single hinged assembly which is bolted into place with an ordinary socket wrench. A cupped gasket of Neoprene, made tight by gasoline pressure, provides a flexible joint for use on rough terrain



the pressure-control dials are luminous, and each nozzle is equipped with an ingenious whistling device which eliminates spilling. The nozzle is placed tightly over the can opening and, as the gasoline flows in, air is forced out through a whistle. Starting as a hiss, the sound gradually rises in pitch and, as the gasoline hits the neck of the

can, it becomes a high warning twitter as a signal to shut off the stream.

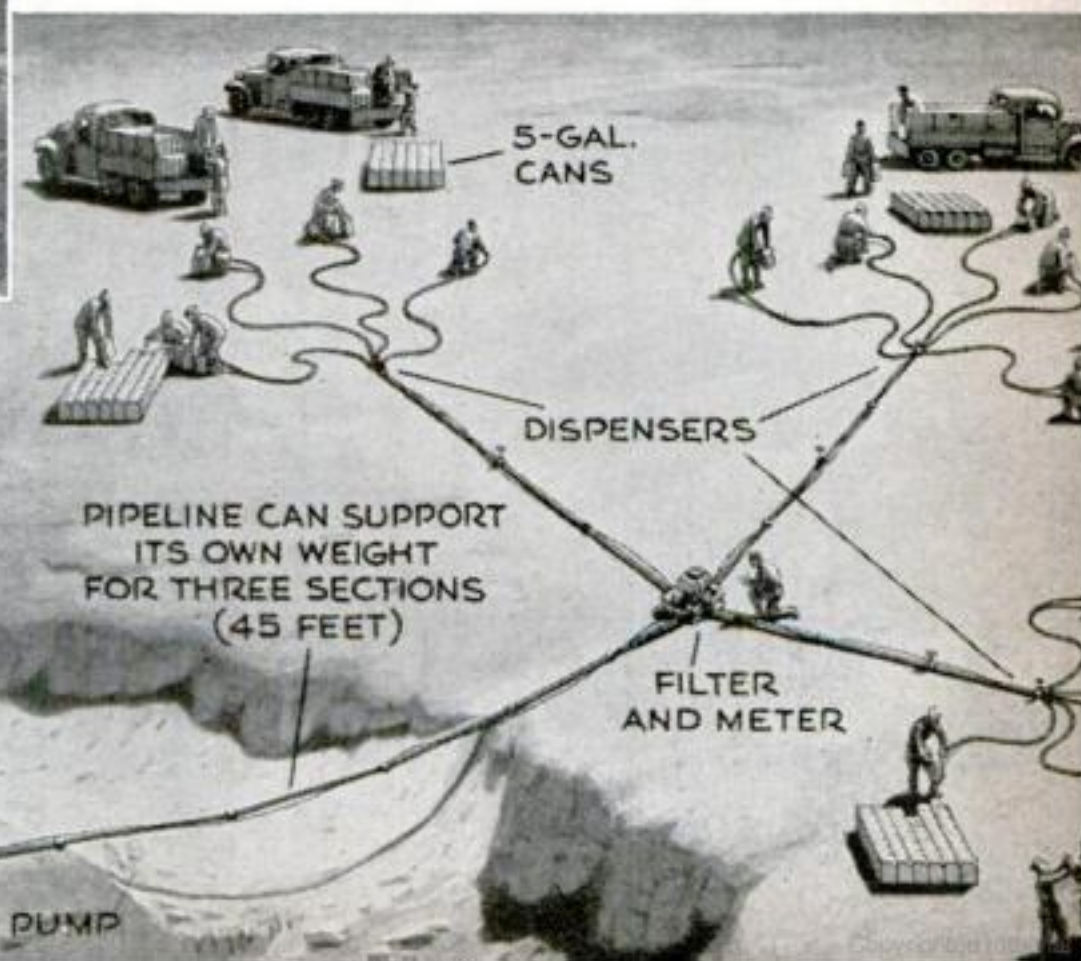
This dispenser efficiently fills a long-felt need, but near such an installation in the Carolina maneuvers was an experimental portable pipe line for the same purpose. Here was merely a tank car with a hose leading from it, and no sign of human



Above, shut-off valves are spotted along the line for quick action if the experimental oscillograph wire shown at its side signals a break by bombing. Below, a booster pump under cover on a long line



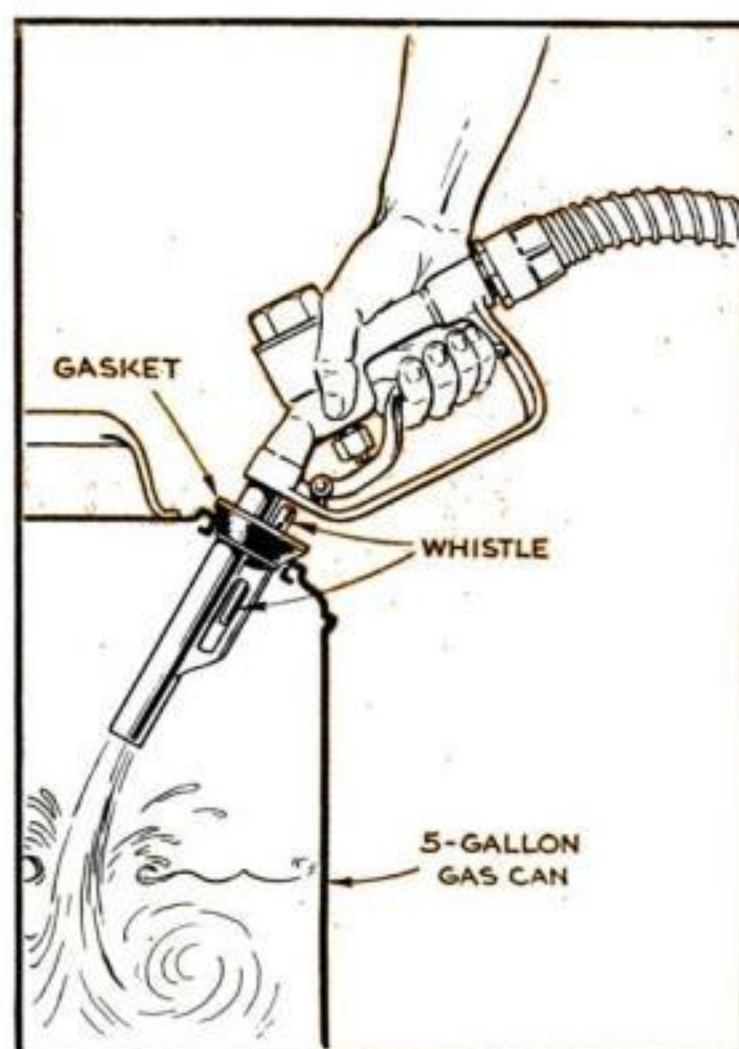
Delivery at the end of the line. This is a flow test run during the maneuvers to determine gallons-per-minute capacity of the line





Dispenser nozzle whistles when can is full to aid at night or during blackouts

Old and new in Army gasoline cans. The new at right is strong, floats when full, has three handles—at center for carrying a single can, at the sides for carrying two



activity. Some distance away, concealed in woods, was the pumping unit, and from there the pipe line ran off to a dump four miles from the telltale tank. Here in hiding, with dumps more widely separated, was a "milker" with twice as many outlets as the portable pump. It could discharge gas twice as rapidly, and could conceivably operate by day as well as night.

While still frankly experimental, this pipe line could be quickly laid over any terrain and deliver gasoline at the rate of 200 gallons a minute. With sufficient outlets on an airfield, it could pump gasoline from a tank miles away and refuel an entire pursuit squadron in ten minutes.

Development of the pipe line began about ten months ago at the Holabird Quartermaster Depot in Baltimore. Two young lieutenants, who had been Standard Oil engineers, were assigned to the development and test of the pipe line. No two had a busier, more interesting time, and probably no outfit was keener on its job than Company E of the 54th Quartermaster Regiment, assigned to work with them.

The equipment is all adapted from commercial products which can be produced in quantity. The basic unit is 15 feet of three-inch pipe, strong enough to hold 1,000 pounds pressure and withstand being run over by a truck, but weighing only 48 pounds, so that one man can carry it. At each end of a section is a flange, about $\frac{1}{8}$ inch thick, over which a coupling is clamped.

The coupling is what makes the line so easily installed and so versatile. It is a single hinged assembly, which clamps shut

over two ends of pipe and bolts tight in one operation, holding the ends together firmly in a flexible joint.

A gasket, made of oil-resistant synthetic rubber (Neoprene) and C-shaped in cross section, fits under the coupling, and the opening spans the pipe joint. When gasoline rushes in under pressure, it fills the cavity in the gasket and expands it into a perfect packing. The higher the pressure, the tighter the joint becomes.

Along with the pipe and couplings go centrifugal booster pumps, powered with 20-horsepower gasoline engines. These are installed at varying intervals, which may be several miles apart for operations in favorable territory.

Assisted by a company of truck drivers to handle transportation, the proposed pipeline company is divided into ten groups, each with equipment on one truck and trailer for one half mile of line—a load of less than five tons, including a booster pump.

The maneuvers gave opportunity for trying many devices and gadgets. The line was laid across a fast-flowing river 1,100 feet wide, both on the bottom and on a level with the surface, suspended by a rubber ponton. A rubber suit, inflated at the chest and ballasted in the feet, was found most useful for laying and repairing the line in water. An oscillograph, designed to give automatic warning of the location of any break, was found to need more work before it was practical. With hose outlets cut and welded in the field, a layout of 14 fueling hoses was installed on the pursuit-plane field at Florence, S. C.



For laying the experimental pipe line across water, the Army tried out a rubber suit and ponton hose. The rubber suit, inflated at the chest, keeps the soldier afloat at the best height for attaching the line to the ponton. Neoprene was used for the hose sections across a stream in the experimental installation. Laying hose on the bottom of the stream was also given a test



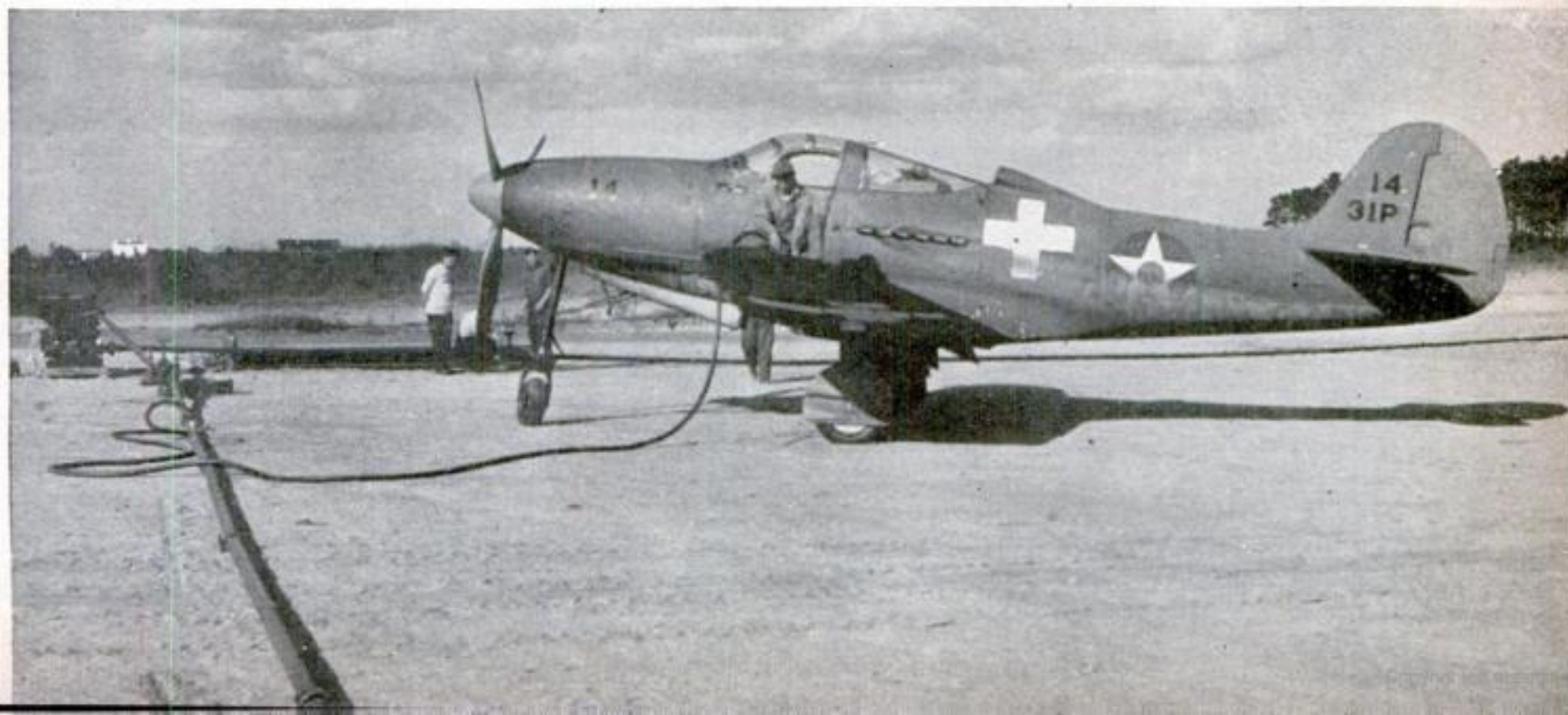
When one considers the possibility that the United States may be landing an overseas expeditionary force at some distant beach head, the versatile uses become even more apparent. Without port facilities, the A.E.F. would have to get its oil from a tank ship off the beach exposed by daylight to merciless bombing.

The contemplated method is for the ship to pump 5,000-gallon tanks full of gas and

float them ashore. The pipe line could be used for emptying these tanks, or in reasonably smooth water it could be floated out to the tanker itself. Several lines could unload a ship as rapidly as the fuel could be dispensed ashore.

New plans like this, in addition to more conventional methods of supply, assure our mechanical monsters of war a steady supply of fuel when they rip into the enemy.

At the First Army maneuvers, gasoline was delivered two miles through the experimental pipe line to a temporary field at Florence, S. C. In action, an entire pursuit squadron might refuel in ten minutes





A balloon-built home. The concrete is sprayed on air-inflated hemisphere and semicylinder fabric forms

Balloon Forms and Sprayed Concrete Speed War Workers' Homes

HEMISPHERIC and semicylindrical balloons of rubberized cotton are being used as forms for molding concrete houses. Built at the rate of 200 in 90 days, these houses offer a means of housing defense workers in small towns where accommodations are limited.

A concrete floor is laid about 23 feet in diameter with sections of pipe at the edge to anchor the flat side of the balloon, which is inflated to a pressure of one and a half pounds to the square inch and covered with

two-inch, 16-gauge wire mesh. Doors and windows are placed to form an integral part of the mesh shell over which an inch of strong, quick-drying concrete is shot by a special gun. This takes two or three hours, and 24 hours later the balloon can be removed.

The outer surface is sealed by an asphalt compound and covered with an inch and a half of insulation, another wire mesh, and a final two- or three-inch coat of concrete. Painting and interior work are conventional.



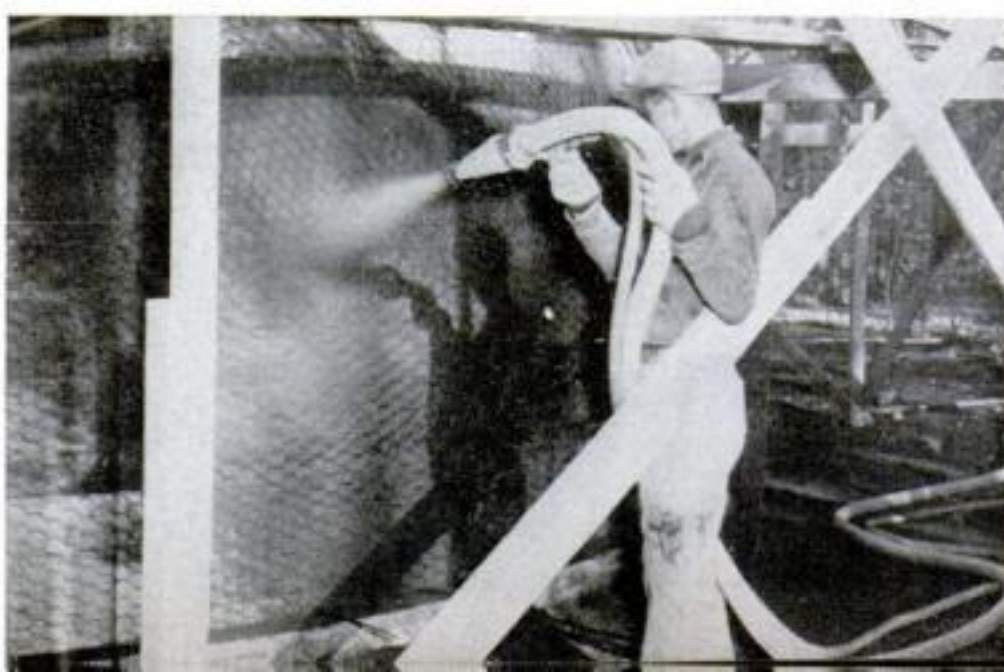
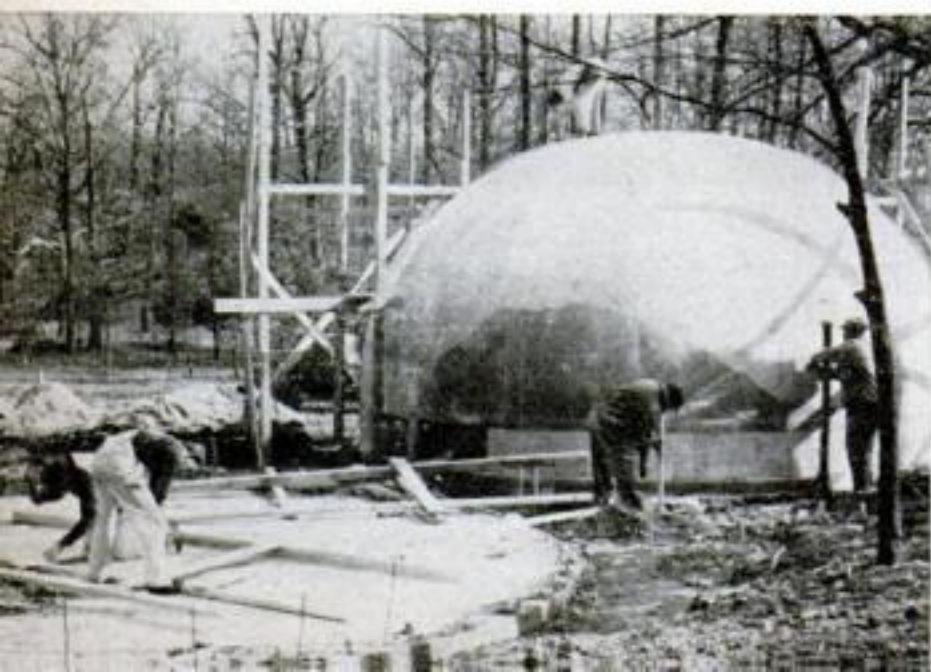
Building procedure: Concrete floor is laid and the balloon form is spread and roped at edges. Next...

Wire mesh is spread over bag, and window and door frames are placed. Into the mesh is now...



... follows inflation with compressed air to pressure of 1½ pounds. Special dusting powder is applied

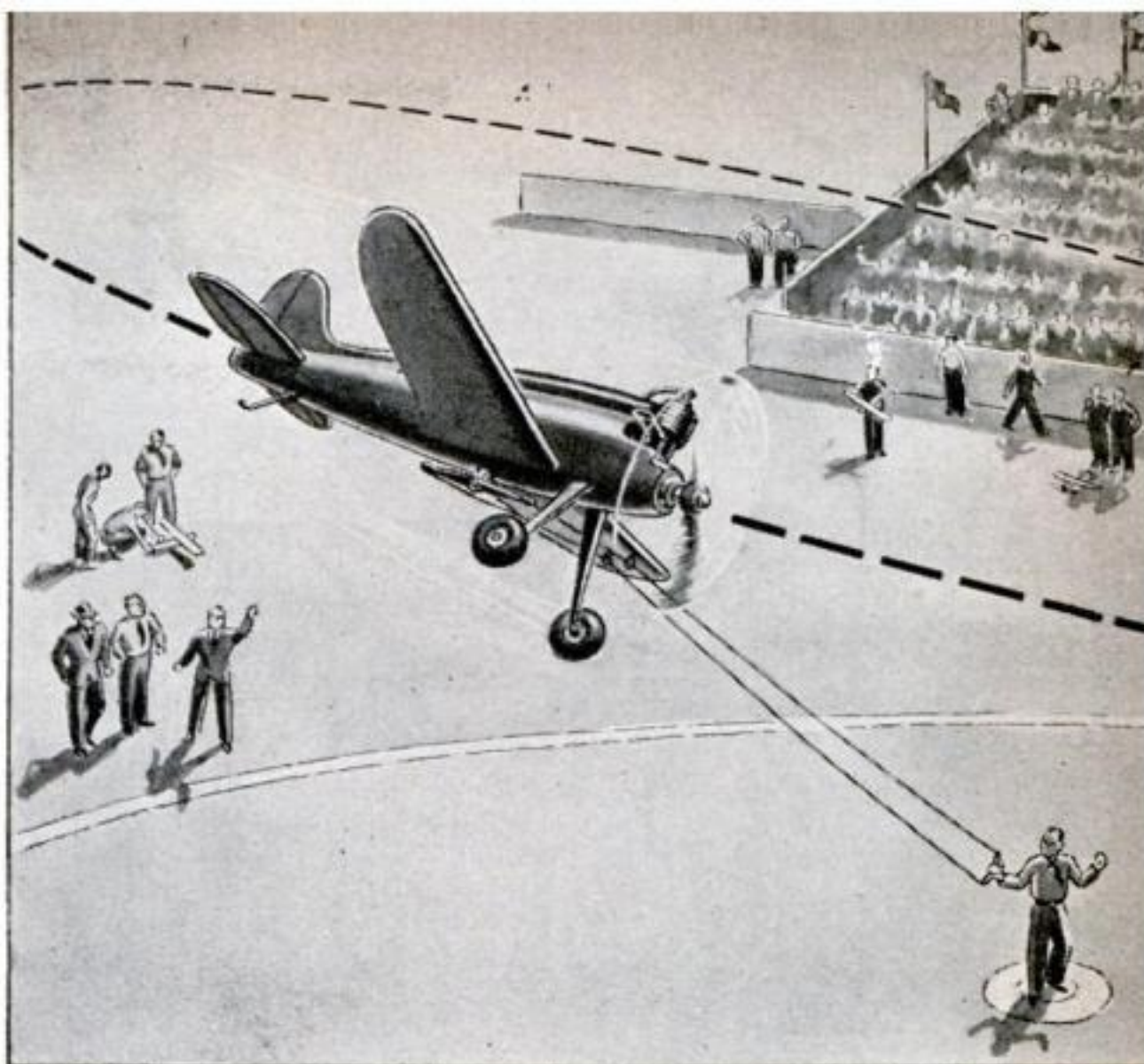
... sprayed quick-drying concrete which sets as a wire-reinforced shell. In 24 hours, bag is removed



Tether Flying

IS NEWEST MODEL SPORT

Whirling dizzily, the model-plane tether flyer spins around on one foot every two seconds or less, handling controls much as a pilot does his stick, until his plane finishes 16 laps, a measured mile

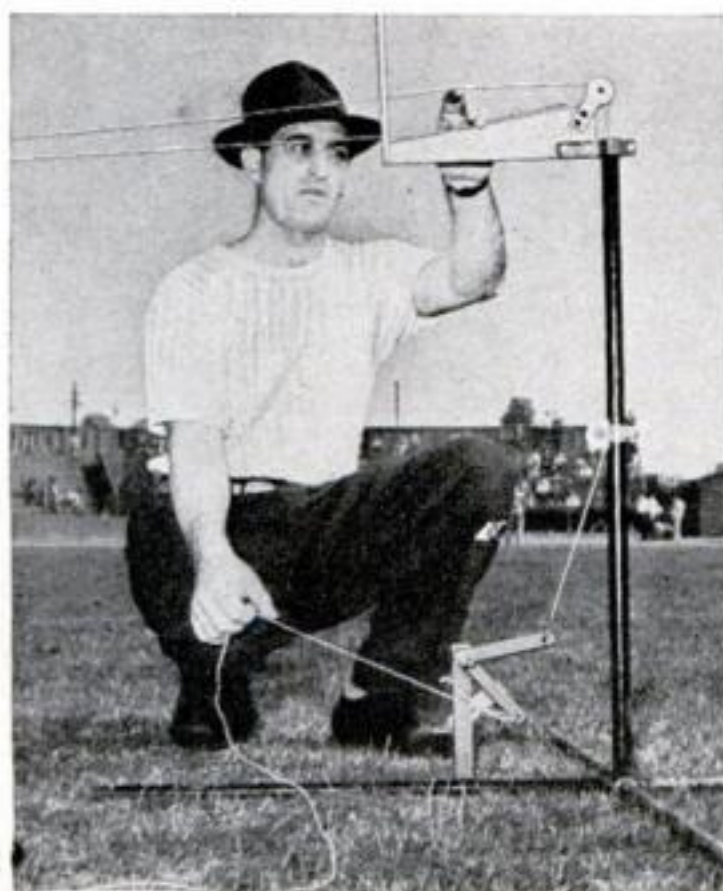


Wires lead through guides on the left wing to a push rod which controls the elevator. Note the smoke sack tied to the fuselage

Below, a view of the controlling crossarm on the underside of a model craft with its streamlined cover removed. This plane uses gasoline in a pencil-like tank, a battery, coil, and condenser



ONLY a few years ago, model airplanes were toys for children, with frail propellers turned by elastic bands—fragile craft that often broke into splinters when they crashed at the end of a slow flight. Now they zip 75 miles an hour in a tight circle, looping, dive-bombing, and dogfighting, their movements guided from the ground by U-shaped handles and fine piano-wire controls. Tether flying is fast sweeping the country. Three hundred clubs have taken up the sport, with more than 20,000 men and boys flying scale



Remote control, the latest kink in tether flying, permits operation from outside the racing circle. The wires lead to a second control at the center which, like a pantograph, duplicates hand motion

models of swift military interceptors and bombers.

All sorts of stunts may be performed. Double sets of wires produce wing-overs and fly ships upside down. Wires control releases for miniature bombs filled with talcum powder. One plane tows a 10-foot sign; another sky-writes. Operators engage in dogfighting, judges from the Army, Navy, and Marine Corps picking as the winner the plane whose "guns" are most often in position to fire effectively.

At the first national championship races at Long Beach, Calif., recently, 35 contestants with 60 planes took part in nearly 150 flights. In the first meet ever held, Don Hodgson of Long Beach souped his little mid-wing up to 69.23 miles an hour. During the championships, Bud Warren, another Southern Californian, clipped off 75.29 m.p.h. with a high-wing model. Many expect to see the 100-mile-an-hour mark reached soon.

U-controlled flying started just over a year ago when Jim Walker, a Portland model manufacturer, devised a method of elevator control by two piano wires leading from a U-shaped plywood handle to a cross arm in the fuselage attached to a push rod. The rod moves the elevator when the U-handle is rocked. To keep the planes on an even keel, the wires run through guides in the lower side of the wing. The rudder is offset slightly, causing the planes to veer outward, thus keeping the wires taut.

But racing by no means closes the book. Thousands are getting flying experience without the cost of actually going into the air. Handling model planes teaches the principles of flight, and both men and boys get the feel of the controls.



Model bombers are controlled by three wires, two moving the elevator, the third releasing "bombs"



This plane has its engine in the center of the wing, power being carried to the propeller through a ten-inch-long extension shaft



At left, a high-wing cabin plane which flies at 40 miles an hour, looping and rolling. It weighs three and a half pounds, is powered by a $\frac{1}{4}$ -horsepower motor



Booklike Kit for Book Shelf Holds Book-Repair Articles

"THE Care and Feeding of Books" is the title of a novel booklike package containing numerous articles for cleaning and repairing damaged books. Included in the kit are such items as a fluid for cleaning and preserving leather, an ink and stain eradiator, a tube of liquid cement, transparent mending tissue, erasers, sponge, and spatula. The package itself is bound in dark-red leather with gold lettering. The "book" is designed to stand between real books on a book shelf.

Labor-Saving Sprinklers Water Wide Areas Automatically



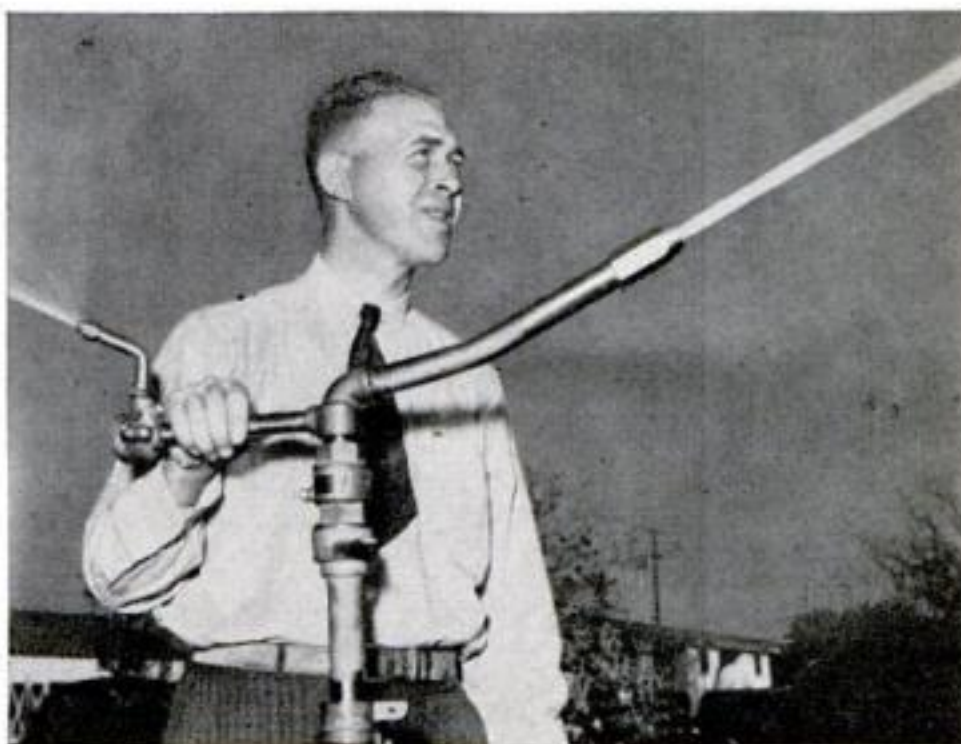
With its three nozzles, this huge unit throws 406 gallons of water a minute over a 350-foot circle

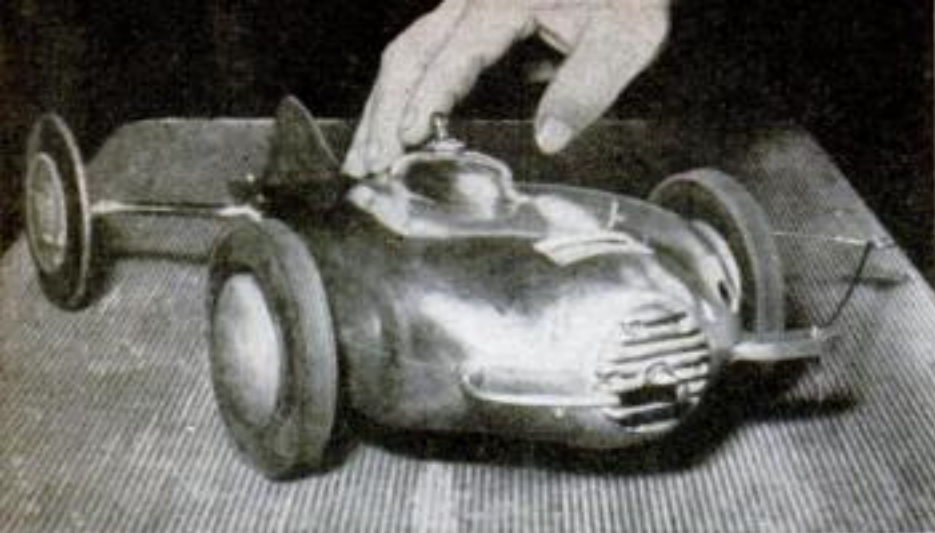


A reaction-type drive turns a drum to wind up cable to pull this unit and a one-inch hose across a lawn

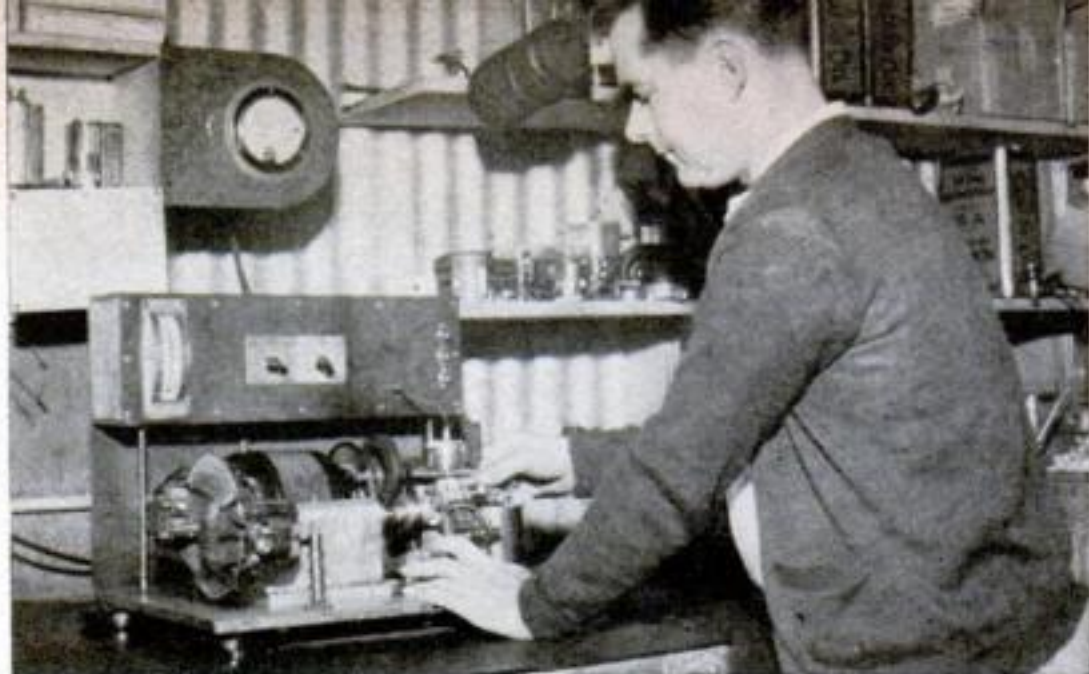
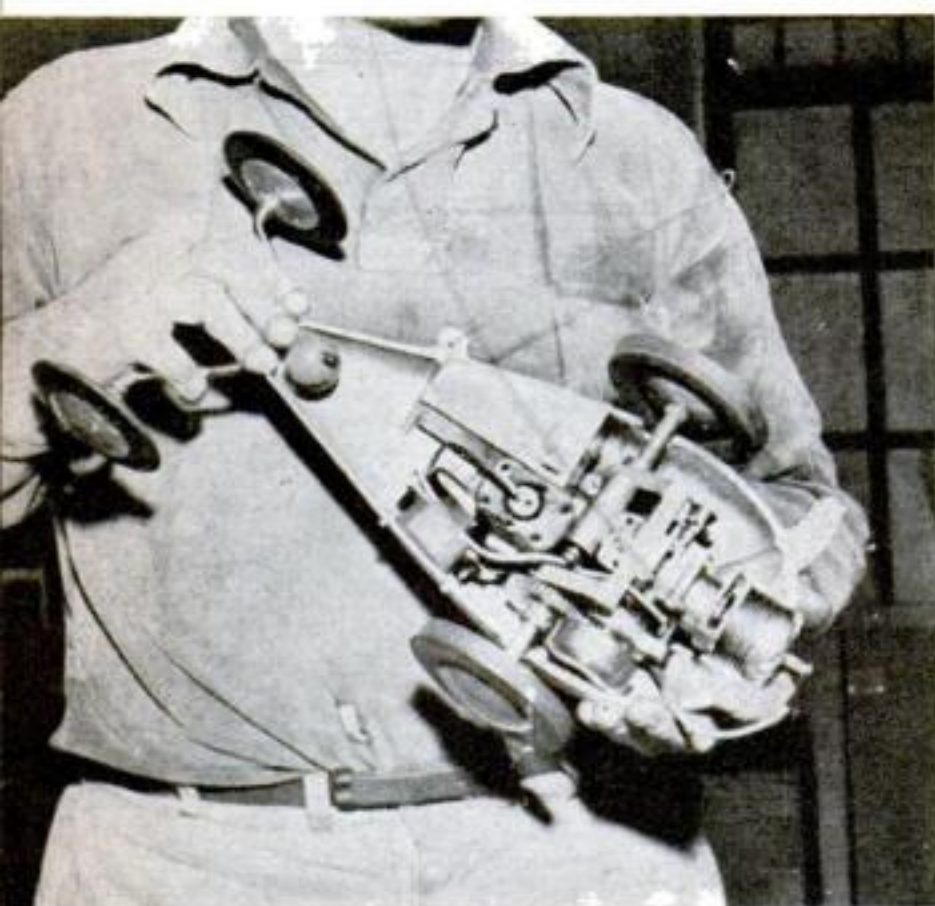
MAKING sprinklers and water spreaders that irrigate everything from lawns and football fields to banana plantations, saving manpower as they work, is the calling of W. A. Buckner, of Fresno, Calif. His irrigators, concealed when not in use, pop up out of the ground when turned on. Or, set at one edge of a golf fairway, they roll themselves along under their own power to cover huge areas without attention, shutting themselves off at the right time. Entirely automatic, his sprinklers derive their power from water pressure which revolves nozzles to help distribute the spray and simultaneously turn wheels, roll up cables, and perform other mechanical functions that are required to make the apparatus move over the ground.

Another giant Buckner sprinkler. Quick-coupled to water pipe, it enables one man to operate it without a hose





Above, the 100-mile-an-hour gasoline-engined car ready to go. The top of the vehicle has been removed, below, to show the arrangement of the parts. Notice the cylinder position



The 1½-horsepower engine being tested. Its ball-bearing-supported crankshaft permits it to turn at 17,000 r.p.m.

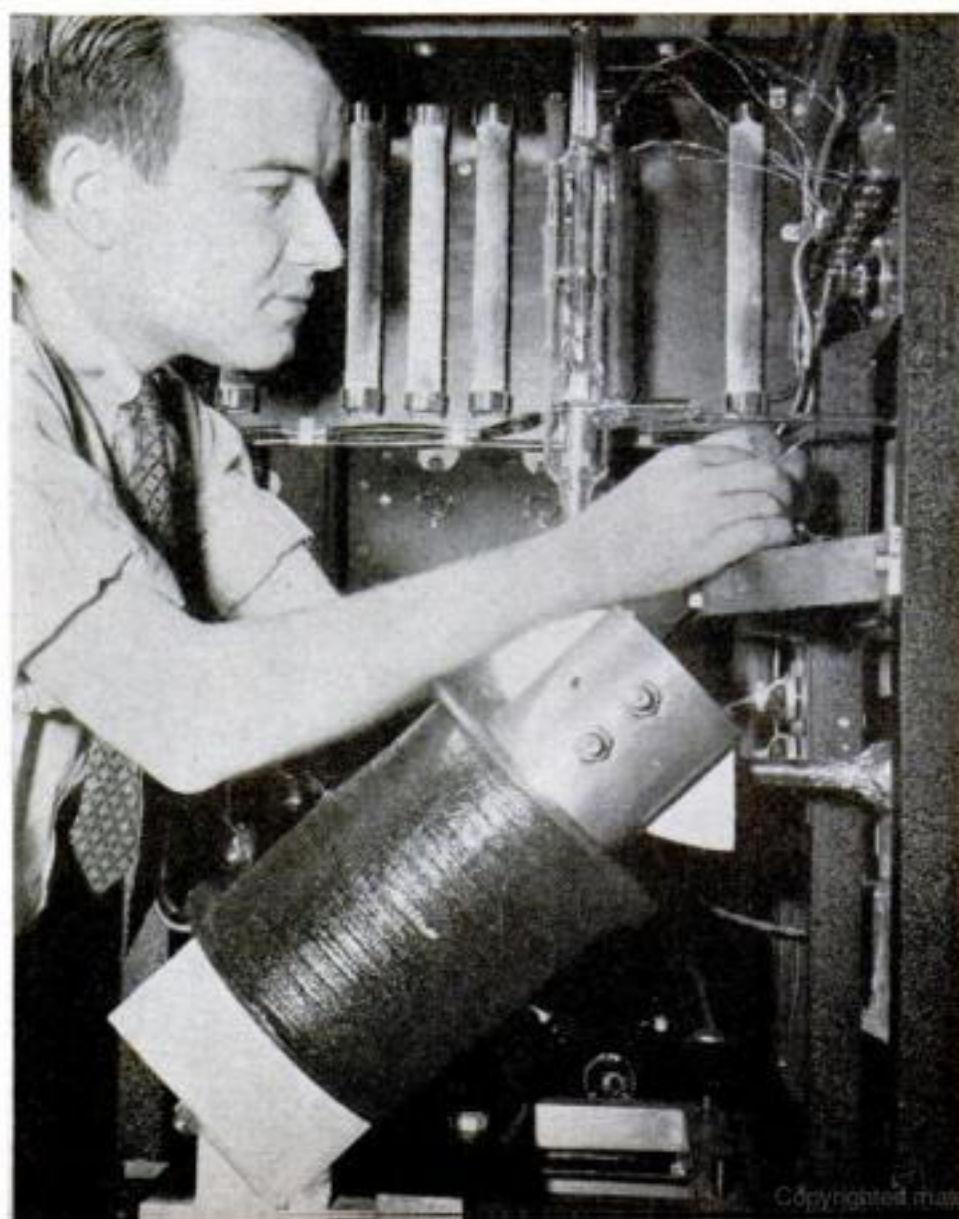
100-Mile-an-Hour Midget Car Is Mostly Motor and Wheels

VIRTUALLY a racing radiator, a midget auto that recently hit 102.5 miles an hour for a half mile is shaped like a teardrop. The car was literally built around its 1½-horsepower gas engine whose cylinder head and spark plug protrude from the front. The horizontal cylinder is tightly clamped to the aluminum-alloy body to dissipate heat generated as the motor clicks off 17,000 r.p.m. Nine tenths of the vehicle's 4½ pounds are carried by the front-drive axle, while the rear axle, shaped like a V, is anchored solely by a rubber ball. It is the creation of four Californians, Walt Cave, Ray Snow, P. I. Matthews, and Roy Imhoff.

Portable Atom Sorter Goes To Work for Industry and Medicine

A PORTABLE atom sorter that helps industrial and medical technicians check quickly the exact chemical content of materials was demonstrated recently at a chemical-industries exhibit. Technically a "mass spectrometer," the compact device first ionizes various atoms of a chemical mixture such as gasoline. The ionized atoms are then "bombaraded" and shot through a curved glass vacuum tube. Magnetic force acting from outside the tube deflects some of the atoms more than others so that on reaching a slit at the end of the tube only those of given weight get through. Varying the magnetic force lets atoms of different known weights through the slit, after which they are counted and classified by means of electrical meters. The unit is mounted on wheels and operates on ordinary house current.

Inspecting inside of atom sorter. Above man's wrist is end of curved glass vacuum tube through which atoms pass as a powerful magnet deflects their paths according to weight



Home Workshops Go to War



TO HELP THE GOVERNMENT CREATE A VAST RESERVOIR OF POWER MACHINES AND SKILLED HANDS FOR FORGING THE WEAPONS OF WAR, POPULAR SCIENCE NOW IS REGISTERING HOME CRAFTSMEN. THE FOLLOWING ARTICLE TELLS HOW THE SHOP FANS OF ONE COMMUNITY ARE ALREADY AIDING THE NATION'S WAR EFFORT. TO LEARN WHAT YOU CAN DO, SEE PAGE 76

By **ARTHUR GRAHAME**

THE \$56,000,000,000 war program outlined by President Roosevelt for the 12 months beginning July 1 calls for the utilization of every mechanical resource of the country. It is not the dollars but the machines and the craftsmanship that will mean success. Expansion of existing shops takes time and there will be only 12 months in which to get our \$56,000,000,000 worth. Undiscovered resources of men and machines must be tapped.

One field has been discovered by Stanley A. Carlson, president and co-owner of a New Jersey machinery company. Mr. Carlson, who enlarged his shop force from 20 men to 200 to make airplane, gun, and bomb-sight parts, found even that force inadequate and began enlisting the home craftsmen living in the vicinity. He found 150 of them within a short time—men who had been making their living as silk workers, garage men, lace salesmen, or in other pursuits but whose fundamental enthusiasms found outlet in their own basement or garage workshops.

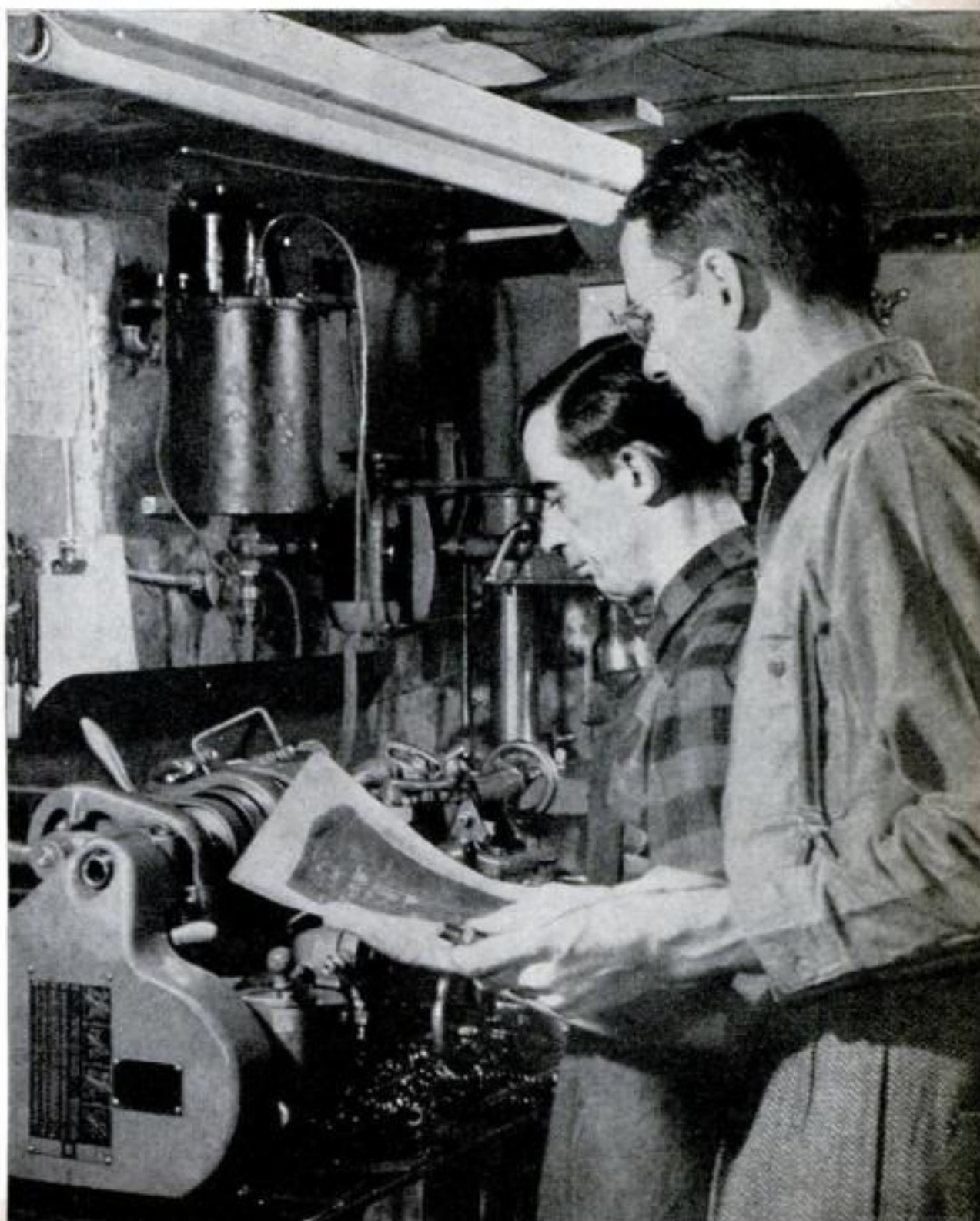
These men, whose delight it had been to build model-railway systems or other complicated projects, became subcontractors, turning out small gun parts or completing sometimes only a single operation on some armament constituent. Some took up the work on a part-time basis. Some,

whose vocational routine had been upset by the priorities program or otherwise, made it a full-time job, a few of them even enlisting several of their acquaintances and setting up small shops.

In the case of those who hired others to help them, the contractor saw to it that labor laws and regulations were observed.

Mr. Carlson, as chief industrial consultant of the Pooling Unit, Division of Contract Distribution in the Office of Production Management, informed Washington authorities of his discovery with the result that a survey is to be made in the United States of what the British call the "Bits and

George Carell supervises the set-up of a lathe with turret attachment in the basement shop where he does subcontracting on defense materials. He has three men on his day shift





In the living room of his home in suburban New Jersey, Carell shows his son, George Jr., a toy battleship as his wife and daughter look on. When mechanical work was just his hobby, he made his children a fine model railroad

Pieces" field of industry. Blanks for registration in this reserve army of craftsmen will be found on other pages of this magazine. Publicity campaigns will seek to inform owners of idle machines of the project and encourage them to register the machines for use should they be needed.

The names of those enrolled in this mechanical reserve will be available in the 100-odd production field offices and an effort will be made to get contractors or subcontractors to let out subcontracts themselves, which would mean that they would have to call on small manufacturers for assistance.

The machine-tool industry increased production from \$225,000,000 to \$425,000,000 in 1940 and is operating now at an annual rate higher than \$850,000,000, but the demand is insatiable because what is needed is tools in operation, not tools in process of manufacture. The time element is dominant.

Nobody knows how many thousands of men there may be in the country who have been utilizing their mechanical skill chiefly for their own amusement, but there are a lot of them, and most of them have tools of their own. The experiment made by Mr. Carlson indicates that their skill is of a high order. Accustomed, many of them, to working on scale models, their standards of accuracy are high. Some of the work which Mr. Carlson farmed out demanded machining to within two one-thousandths of an inch and his craftsmen did a perfect job.

"We have a great reservoir of vitally important machine tools in home workshops,"

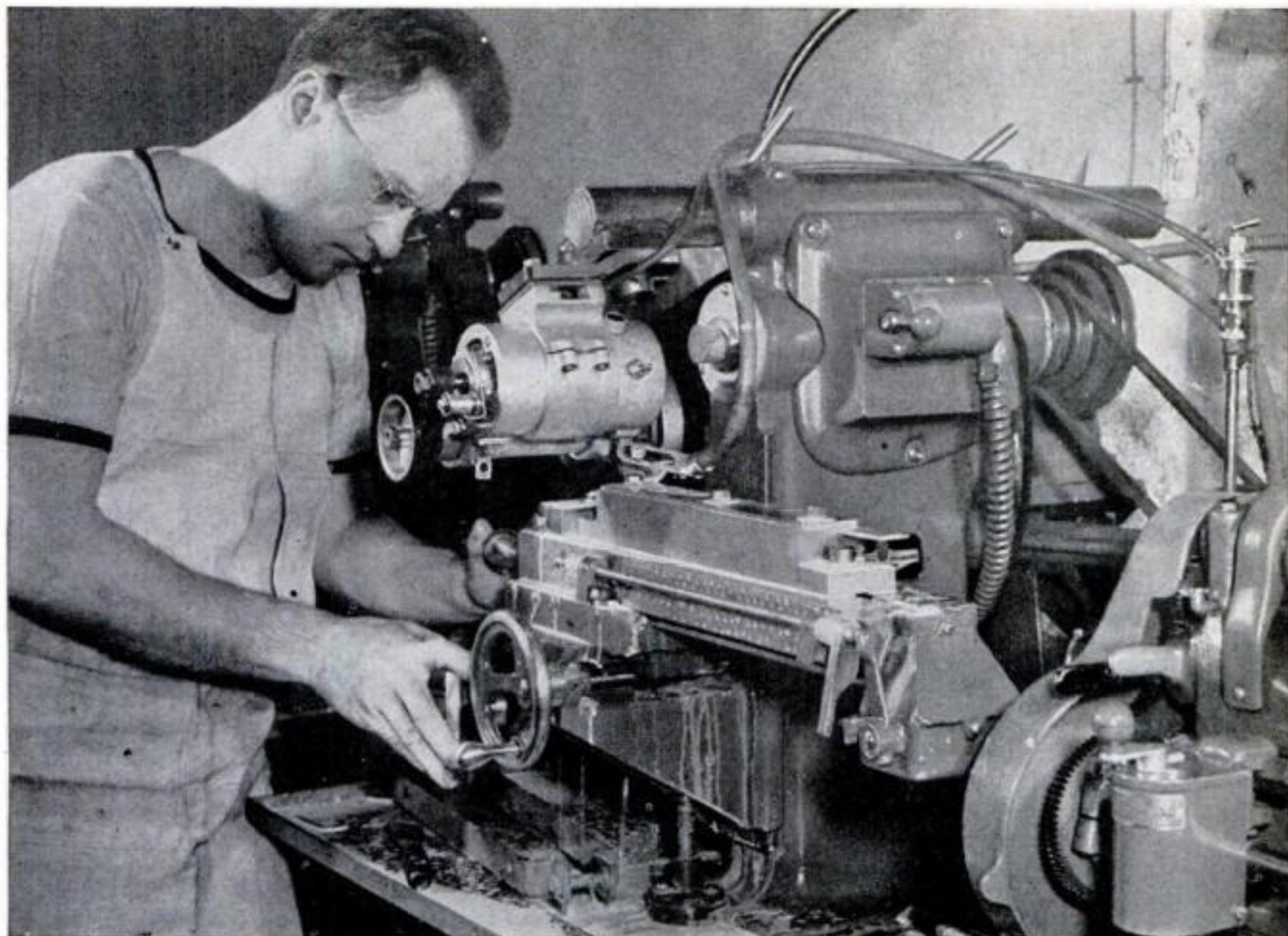
This is the exterior of the Carell home. The side door admits authorized visitors to the busy shop. A stenciled sign on the stair says: "Positively No Admittance. U.S. Defense Work"



Carlson says, "and they must be used. Manned by hobbyists and willing workers, they will help to give our fighting men the weapons they must have to win the war."

Mr. Carlson himself is a Middle Westerner, 36 years old, who studied engineering for a short time at Lewis Institute in Chicago and headed East when his Chicago job sank in the depression. With George W. Bogdanffy, a Bulgarian who had served a three-year apprenticeship in a machine shop before coming to the United States at the age of 14, Mr. Carlson bought control of the machinery company shop. That was six years ago.

When the defense-production drive got going, they went after several of the big prime contractors and got subcontracts to make such bits and pieces as small tools used in the manufacture of machine-gun tracer bullets, metal parts for airplane propellers, special airplane maintenance tools, small parts for ship fittings, and component parts for tank-gun firing mechanisms and gun and bomb sights. To handle this work they bought all the new and secondhand machine tools they could get hold of, opened an emergency plant in a near-by town and increased their working force. But in



An example of Carell's ingenuity is this small milling machine which he rigged up with a grinder to form a surface-grinding machine. He also installed a cooling system. Operator is Walter Drzewiecki

spite of this expansion orders began to pile up. Even if they could find more machine tools—which they couldn't—they wouldn't be able to jam them into either of their plants. So they decided to subcontract some of their work. That didn't pan out because they couldn't find any subcontractors. The defense boom was on in the New Jersey industrial region, and every back-street machine shop had more work than it could handle.

Being both patriotic citizens and good businessmen, Carlson and Bogdanffy hated to turn down work which the country needed and which would bring them good profits, but there didn't seem to be anything else they could do. Then one day last spring Carlson had an idea. When John Lindstrom, a Swedish-born expert machinist who had worked in Carlson's plant for several years, came into his office on some errand, he remembered that John's hobby was experimental toolmaking and that he had a good lathe in a little workshop in the basement of his house. If he would agree to use that lathe to do at home the same work he was doing in the plant, it would make his plant lathe available for another machinist, and increase production by that much.

He offered to pay Lindstrom his regular wages and overtime, and something extra for overhead. John was willing to try it, and went home with material for an order for parts which had to be machined to .002-inch accuracy. A few days later he brought in the completed job. In all the time he had worked for Carlson he'd never had any work rejected. But Albert Kuehn, the company's general superintendent and engineering trouble-shooter, wasn't quite certain how his sudden shift from a completely equipped plant to a basement workshop would affect his craftsmanship, so he made the inspection himself. It didn't result in any tarnish on John's record. The parts were perfect.

Lindstrom continued to work at home. After he'd been at it for a few weeks he came into Carlson's office with a three-day crop of whiskers and a worried look on his normally clean-shaved and placid face. Carlson asked him what was the matter. He'd been doing a lot of thinking, John said. Ever since he'd been an apprentice back in Sweden he had been dreaming of owning his own machine shop. Now, maybe, he could make his dream come true. He had his lathe and a good small drill press,



U. S. Wants ALL Home-Workshop Owners to Register for War Production

IT is urgently necessary to find out at once what contribution the home workshops of the United States can make in the production of war materials.

To obtain this information with the least possible delay, POPULAR SCIENCE MONTHLY is making a survey to be placed at the disposal of the U. S. war production facilities. All readers who are able to devote any time to work of this type are asked to fill out the registration form appearing on the four following pages. Please read the questions carefully and answer them completely. Do this at once.

The reason we are making this survey is that the Government itself desires to have the fullest information relating to the home-workshop field. The facts will be tabulated and made available to the Government. The individual forms, when properly filled out, will then be distributed to the field offices which have been set up by the Government to facilitate the distribution of contracts.

The purpose of the registration is to provide a comprehensive survey of immediately available

home-workshop facilities—manpower, skills, and equipment. Only by making such a survey is it possible for the Government to formulate a nation-wide plan to utilize the tremendous industrial reserve power represented by these small shops.

It must be made clear that no such plan can be prepared until the survey is completed. When we are asking you to do now—and all we are asking you to do—is to say that you will devote your skill, your shop equipment, and your spare time or full time to this work if and when the Government asks you to do so.

It should also be made clear that this work is not to be contributed without pay. If it becomes possible to use your mechanical ability in this way, you will be provided with the necessary materials and paid for the work you do.

A remarkably successful experiment has already been made, as described in the accompanying article by Arthur Grahame. The same general method of procedure will be followed, as far as possible, in all the districts supervised by the Government field offices.

(Continued from page 75)

and he had tracked down and bought a rusty old milling machine and had done enough work on it to be certain that he could make it serviceable. He had a friend who was a good amateur machinist who wanted to go to work for him. He'd let his car stand out in the yard and turn his garage into a shop. If he went in for himself would Mr. Carlson give him some sub-contracts?

Carlson knows the men who work for him, and he speaks their language. He

knew that Lindstrom is a magnificent craftsman and a straight shooter. "Sure thing, John," he said. "If you need any money to get started, holler."

He'd found his first subcontractor. That evening he went into a huddle with Bogdanffy and Kuehn. They agreed that there must be other home-workshop enthusiasts in the vicinity, and that some of them probably had machine tools that were standing idle, and that it would be worth while to try to find them. Next day this advertisement appeared *(Continued on page 78)*



At left, George W. Bogdanffy, vice president of the machinery company, explains a job to John Lindstrom. Formerly an employee, Lindstrom now is his own boss doing subcontracting in a small machine shop in the rear of his home. Provided with blueprints and a sample of the part to be manufactured, he is supplied with material by Albert Kuehn (right), general superintendent of the company. He will return the finished parts for inspection when work is done



POPULAR SCIENCE

Work of this type, as in the case of the experimental set-up, is done for contractors and subcontractors, not directly for the Government. Because of this, home-workshop operators are freed of all red tape involved in so-called "direct procurement." They are supplied with materials, so they do not have the difficulty of obtaining their own. They are also given various production aids, bookkeeping assistance, and other help by the concerns for which they work.

The primary handicap that this survey is intended to overcome is the fact that contractors and subcontractors do not, as a rule, know of the existence of well-equipped home workshops in their own localities. This registration will build up a reservoir of ready, willing, and effective help in every part of the country. Upon this reservoir the contractors and subcontractors will be able to draw freely at will.

Please bear in mind that even the task of surveying available home workshops is a gigantic one. Because the task is so immense and because every one concerned is straining to increase production as quickly as possible, we ask that those readers who fill out the form do not become impatient. Above all, **DO NOT WRITE, PHONE, OR VISIT** the district offices to inquire about registrations. It will simply impede matters and cause confusion and delay.

The thing for you to do — and do now — is to register. Headlines in every newspaper emphasize

the urgency of the matter. It was never put more forcibly than in President Roosevelt's recent message to Congress on the state of the Union, in which he said: "We must convert every available plant and tool to war production. That goes all the way from the greatest plants to the smallest — from the huge automobile industry to the village machine shop."

It may be that you have had valuable mechanical experience, but do not own any machine tools. Fill out the blank nevertheless, because the survey is certain to reveal much unused equipment that can be borrowed, rented, or bought. On the other hand, if you own a screw-cutting lathe or other first-class machines, but are not expert in using them, list them on the form. Perhaps some man may be found in your locality who can use your shop equipment. Even if you have no mechanical ability and no equipment, you can still help by calling this notice to the attention of anyone you know who is a hobbyist along mechanical lines.

Members of the hundreds of home-workshop clubs affiliated with the National Homeworkshop Guild are especially urged to participate in this survey. Bring up the matter at the next club meeting, or have a special meeting called for the purpose.

To win the war, men and machines must be mobilized in one great, all-out effort. Do your part by filling out the survey form today.

WAR-WORK REGISTRATION FORM FOR HOME CRAFTSMEN

Note: If you wish to avoid cutting these pages, you may obtain a duplicate of this form by sending a self-addressed, stamped envelope to Popular Science Monthly.

5

NAME

(Please print or typewrite)

STREET ADDRESS

CITY OR TOWN

COUNTY

STATE

Age

Occupation

Position held

Are you regularly employed, employed part time, unemployed, or a student?

Check the schools from which you have been graduated.

☐ Grade school

☐ High school

☐ Vocational school

☐ Correspondence school (

..... course)

☐ College (major subject,

What mechanical experience have you had?

FORM CONTINUES ON NEXT PAGE →

(Continued from page 76) in a New Jersey newspaper.

"Toolmakers, machinists, hobbyists, if you have an idle machine in your basement that you are willing to use in the interest of national defense, write at once giving full particulars as to your equipment and abilities."

Seventy-five answers came from all over the surrounding area—most of them from home-workshop hobbyists who were holding down regular jobs, but some from textile-mill workers who had been thrown out of work by the silk shortage. One of the plant engineers, Sam Pecorino—New Jersey born of Italian parents—was put in charge of transforming as many as possible of them into subcontractors. Armed with a roll of blueprints and a suitcase loaded with samples, he visited each applicant. Some of them he had to eliminate because they didn't have adequate machine tools; others because a few minutes' conversation made it plain that their enthusiasm for national defense was much greater than their skill and experience as amateur machinists. When a man was a possibility Pecorino decided what sort of work he was best fitted to do, showed him how to do it, and gave him material with which to make a sample. If the part he turned out passed rigid inspection, he was given a contract. Some

workers who didn't have tools of sufficiently high quality to do precision work were given contracts to rough out parts which were turned over to the better-equipped craftsmen for finishing.

Thirty-five of the 75 men who answered the newspaper advertisement proved that they could do work of the required high quality. Advertisements in several other New Jersey newspapers added to the number of home-workshop subcontractors who, by using their particular talents and skills in the way in which they count most heavily, are in a very practical way helping to beat Hitler. Some of them have found it profitable to give up their usual occupations, hire helpers, and give all their time and effort to what has turned out to be a decidedly worth-while business. More of them make war production an off-time job to which they devote anywhere from 25 to 60 hours a week. Full or part time, there are now about 150 men engaged in the work.

Home-workshop subcontracting is Stanley Carlson's baby and he is an enthusiastic father, but he admits that there is one aspect of it which gave him a big surprise. Looking over the records for the past few months, he found that the subcontractors who do their work in basements and garages have had a lower percentage of rejections of work for inaccuracy or faulty

Check which of these machines (or equipment) you can operate, and add any not listed.

	Grade		Grade
<input type="checkbox"/> Metal-turning lathe	<input type="checkbox"/> Metal shaper
<input type="checkbox"/> Drill press	<input type="checkbox"/> Screw machine
<input type="checkbox"/> Milling machine	<input type="checkbox"/> Boring machine
<input type="checkbox"/> Welding (arc, spot, torch)	<input type="checkbox"/> Heat-treating
<input type="checkbox"/> Grinding (surface, etc.)	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

Note: After each machine or type of equipment you have checked, please add one of the following letters to indicate the degree of skill you possess: E for expert or foreman grade. J for journeyman or average grade. S for semi-skilled or apprentice grade. B for beginner.

Can you read simple blueprints?

What mechanical projects, articles, or parts have you constructed, either for pay or as a hobby?

If you operate a metal-turning lathe or other machine-shop tool, what is the minimum tolerance to which you are accustomed to work?

FORM CONTINUES ON NEXT PAGE →

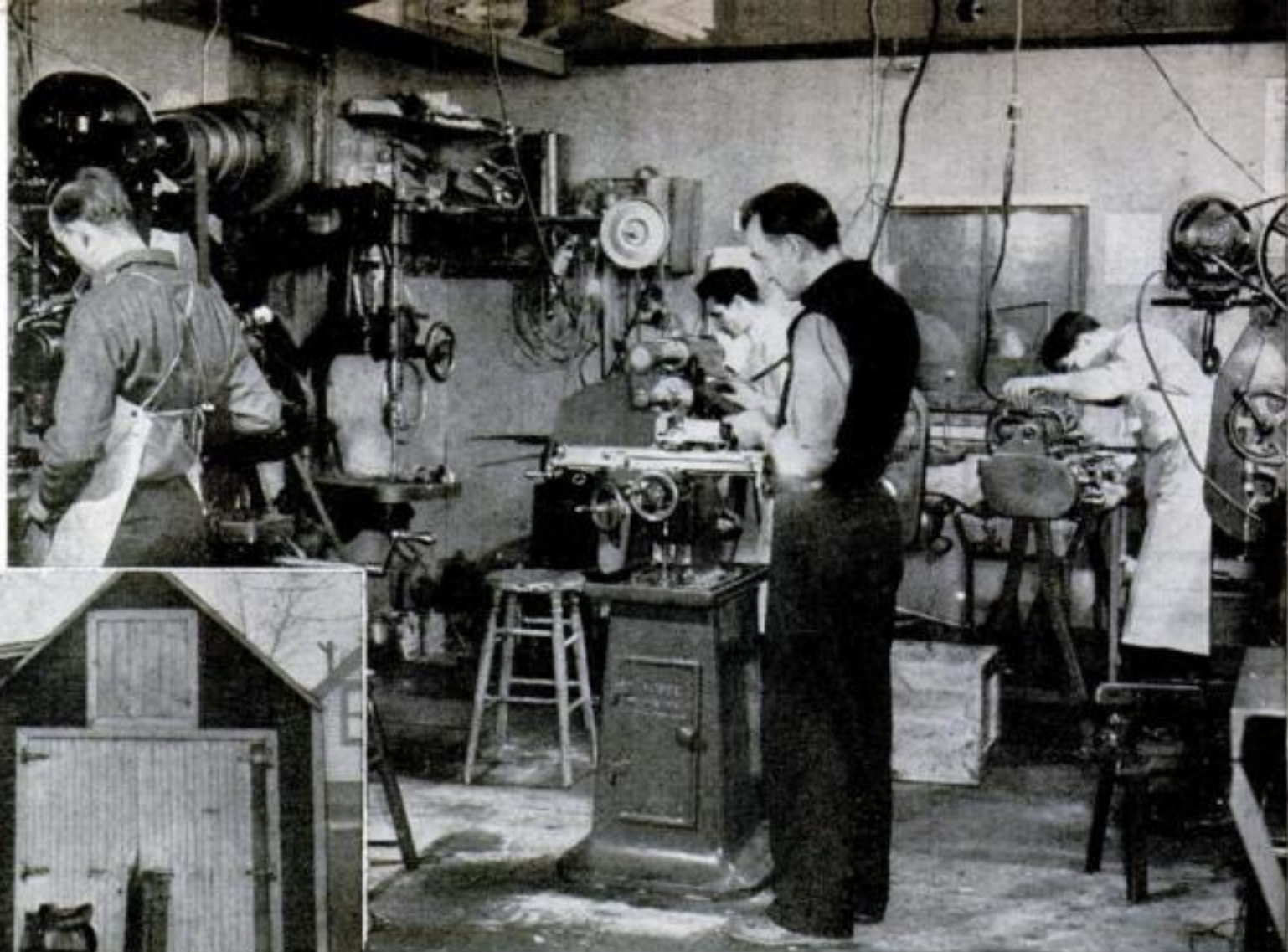
One reason why the subcontractors are successful and enthusiastic is that they get plenty of coöperation and help from the company's management. Every effort is made to give each man only work which he is equipped to do well and which will be profitable to him. When subcontractors who have proved their ability want to increase their equipment and have a chance to buy new or secondhand machine tools, the company finances the purchase. When technical difficulties crop up, Kuehn and Pecorino are available for competent advice and friendly suggestions. The subcontractors show their appreciation of this sort of treatment when there is a rush job to be gotten out. On several occasions, some of them have worked for 30 hours without a

The first morning he stopped his car in front of a quiet-looking house in a quiet street in a suburban town. "This is George Carell's," he told me as he led the way toward a side door. "He's one of our best men—he does really beautiful precision work. When he answered our advertisement he was a salesman for an oil company. Mechanical work always has been his hobby. While he was doing it for fun, he made his wife a sewing machine and a vacuum cleaner, and built his three kids one of the finest model railroad systems I've ever seen—and I know my model railroads. When he started with us, about the only equipment he had was a lathe, but he has picked up a lot of fine machine tools since then. He worked part-time for several months, made a good deal of money, and then started out for himself. Now he has three men on his day shift, and several who work for a few hours in the evening. He averages close to 18 hours a day himself. One of the best men is a hobbyist who was the manager of a New York lace-importing

[illegible]

FORM CONTINUES ON NEXT PAGE →

Lindstrom put his car in the yard to make room for his shop in the garage. At right, he is working at the small milling machine in the center of the room. Below, he stands outside the shop with Mrs. Lindstrom and their two children, John, 10, and Nancy, 7



house for a good many years. When the war started, he lost his job, but now he's making good money with Carell. Here we are." He opened the side door. Over a stairway

leading down to the basement, there was a stenciled sign reading: "Positively No Admittance. U. S. Defense Work." Up the stairs came the low hum of smoothly-running machinery, and the faintly sweet smell of warm machine oil. We went down. Except in a submarine, I've never seen so much machinery in so (Continued on page 222)

Are you able to give instruction in machine-shop practice to others?..... How many hours a week could you teach?..... Could your own machines and equipment be used for such instruction?.....

If you are familiar with any part or assembly of war matériel which you would be especially interested in making, please describe it as completely as possible.....

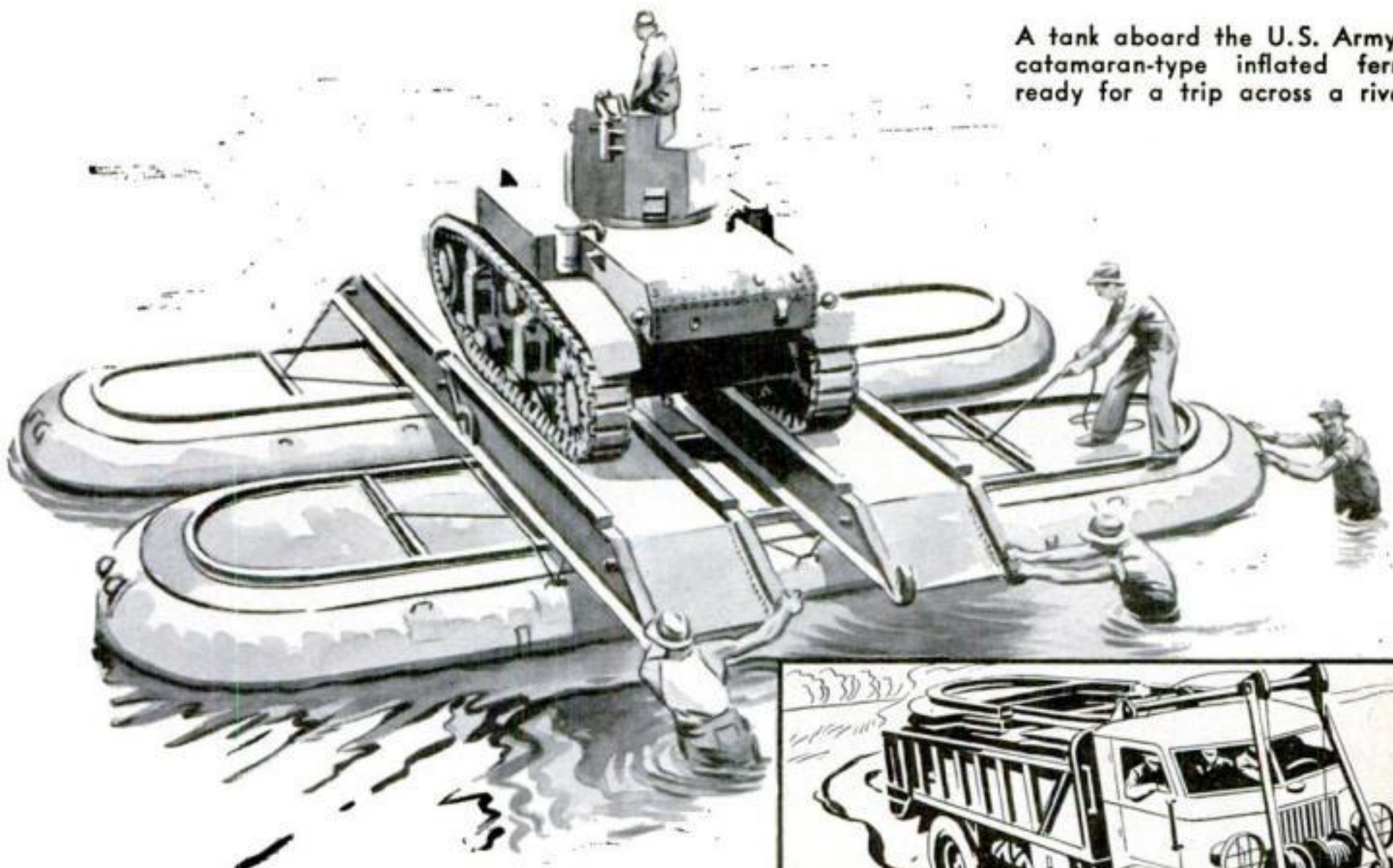
.....

List the names and addresses of other mechanically minded men who might be interested in enrolling for this type of work so that registration forms may be mailed to them.

.....

IT IS URGENT THAT THIS SURVEY BE COMPLETED AS QUICKLY AS POSSIBLE. PLEASE FILL OUT THE FORM IMMEDIATELY IF YOU ARE ABLE TO HELP PRODUCTION IN ANY OF THE WAYS MENTIONED. ADDRESS WAR-WORK REGISTRATION, POPULAR SCIENCE MONTHLY, 353 FOURTH AVENUE, NEW YORK, AND MAIL AT ONCE.

A tank aboard the U.S. Army's catamaran-type inflated ferry ready for a trip across a river

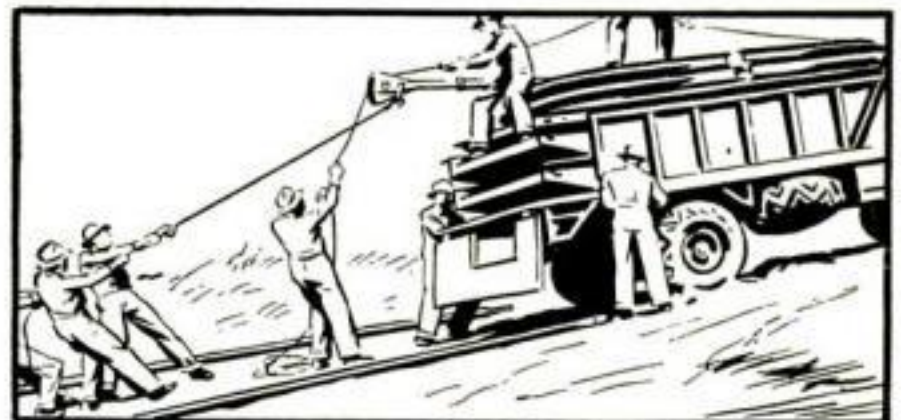


Tanks Ride Across Streams on Portable Rubber Ferry Assembled in 20 Minutes

A PORTABLE FERRY for war tanks, recently demonstrated by U. S. Army engineers at Fort Knox, Ky., speeds armored divisions across rivers at tactically important points where bridges are lacking or destroyed. Rushed to the scene in a special truck, the knocked-down craft can be assembled by practiced hands in 20 minutes or less. A telescoping crane, extended to full length, unloads heavy metal plates, which the truck crew puts together to form rigid decks for a pair of inflated rubber boats. When the decking has been lowered into place, the boats are fastened side by side and a runway resembling an automobile greasing platform is laid across them and lashed down securely. A tank lumbers aboard, and the ferry is ready to go. Hand paddles or outboard motors propel the odd conveyances to the opposite side, while guide cables stretched from shore to shore keep them from being carried downstream with the current. Oversize balloon tires keep the trucks from bogging down in marshy or sandy country.



A truck carries the knocked-down craft to the spot



... where a telescoping crane is quickly extended



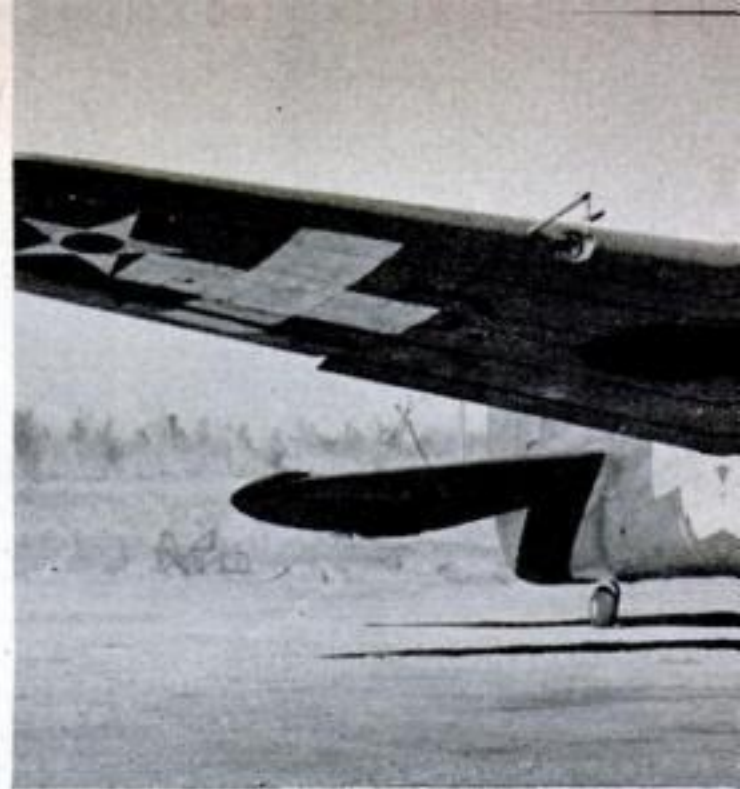
... to unload the sections of the two metal decks

Assembled decks are lifted onto the inflated boats





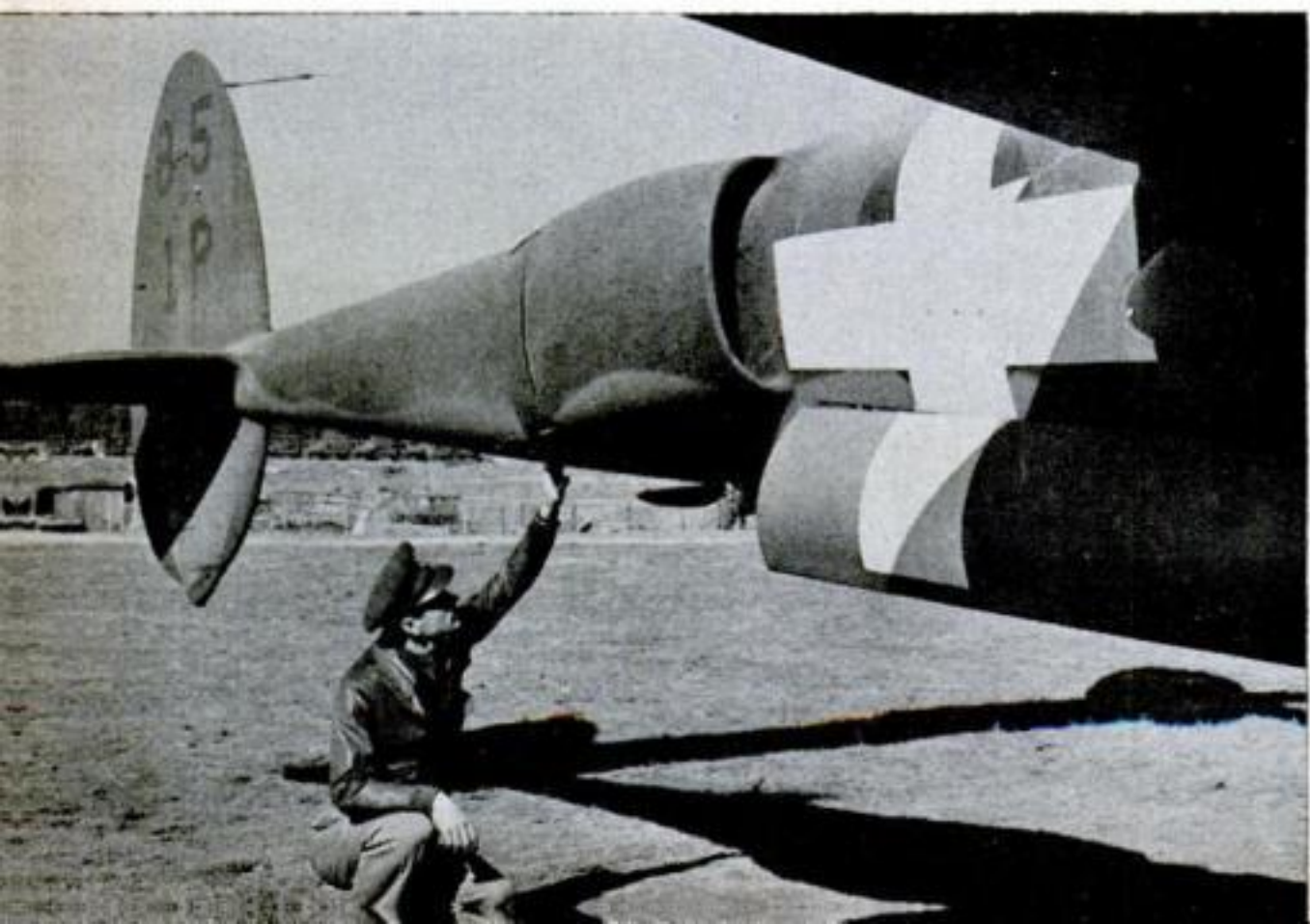
Meet Howie Olsen, one of Uncle Sam's 1942-model air observers. Just two years ago he was running two filling stations in Madison, Wis. Now he's in the fastest-changing branch of military aviation



Before

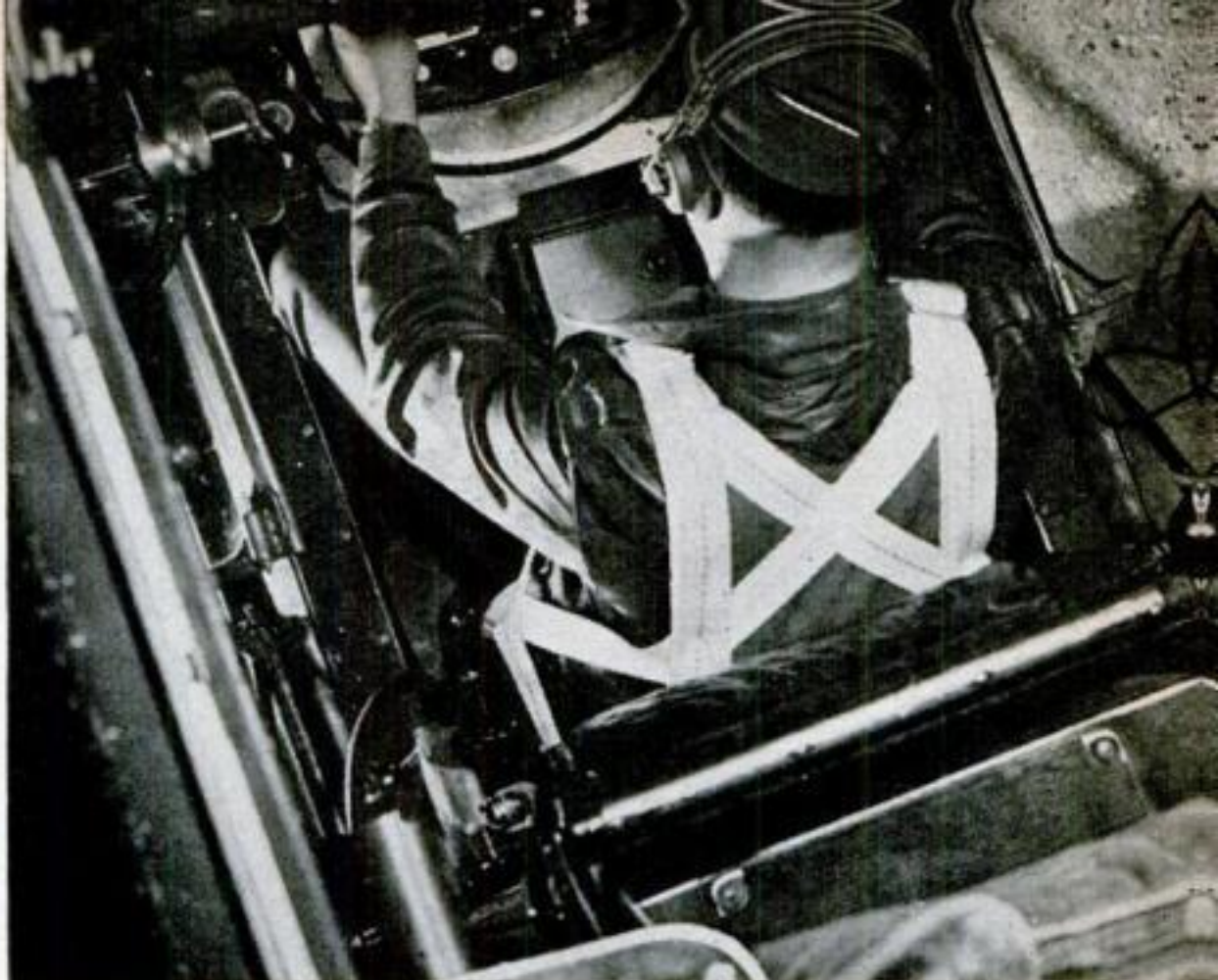
WHEN young Howard P. Olsen joined up with the Army as an air observer, he had no idea he would soon be up to his ears in some of the fastest, most exciting, rapidly changing doings in military science. But as matters are moving now, he may even turn out to be a

Because the O-47 isn't fast enough to stand the pace of many observation jobs in combat areas, pursuit ships are also being used for this vital work. The photos below show how a P-38 is adapted to the purpose, with a camera mounted vertically in one of its tail supports. To get an oblique shot, the plane is banked





In the O-47, the observer rides between pilot and gunner, climbs down a ladder to use the camera in the belly of the plane (arrow)



The Bomber—Observation

HOT SHIPS TAKE OVER AS EYES OF THE ARMY

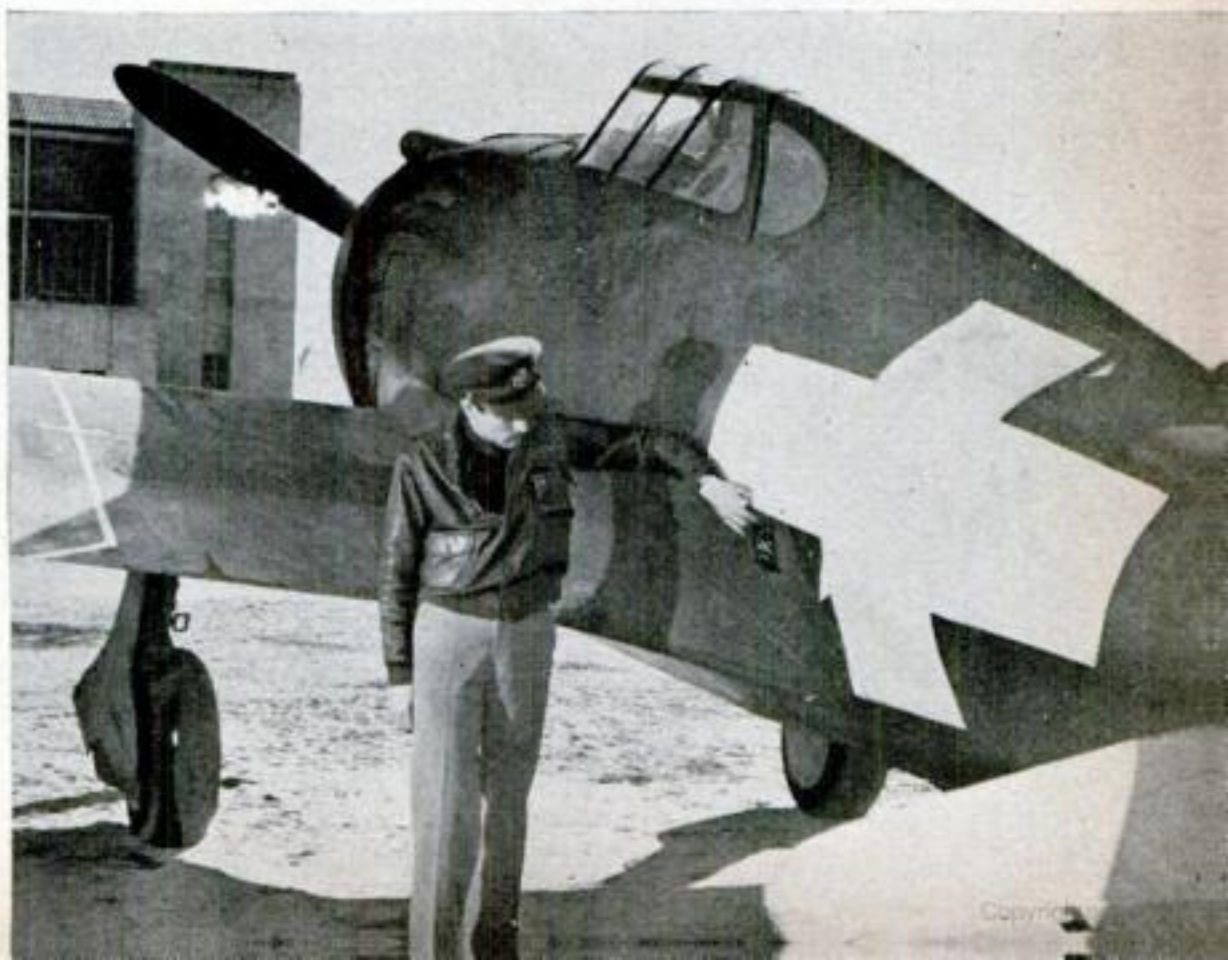
romantic figure. That would surprise nobody more than Howie. He wasn't looking for glory when he joined the 126th Observation Squadron.

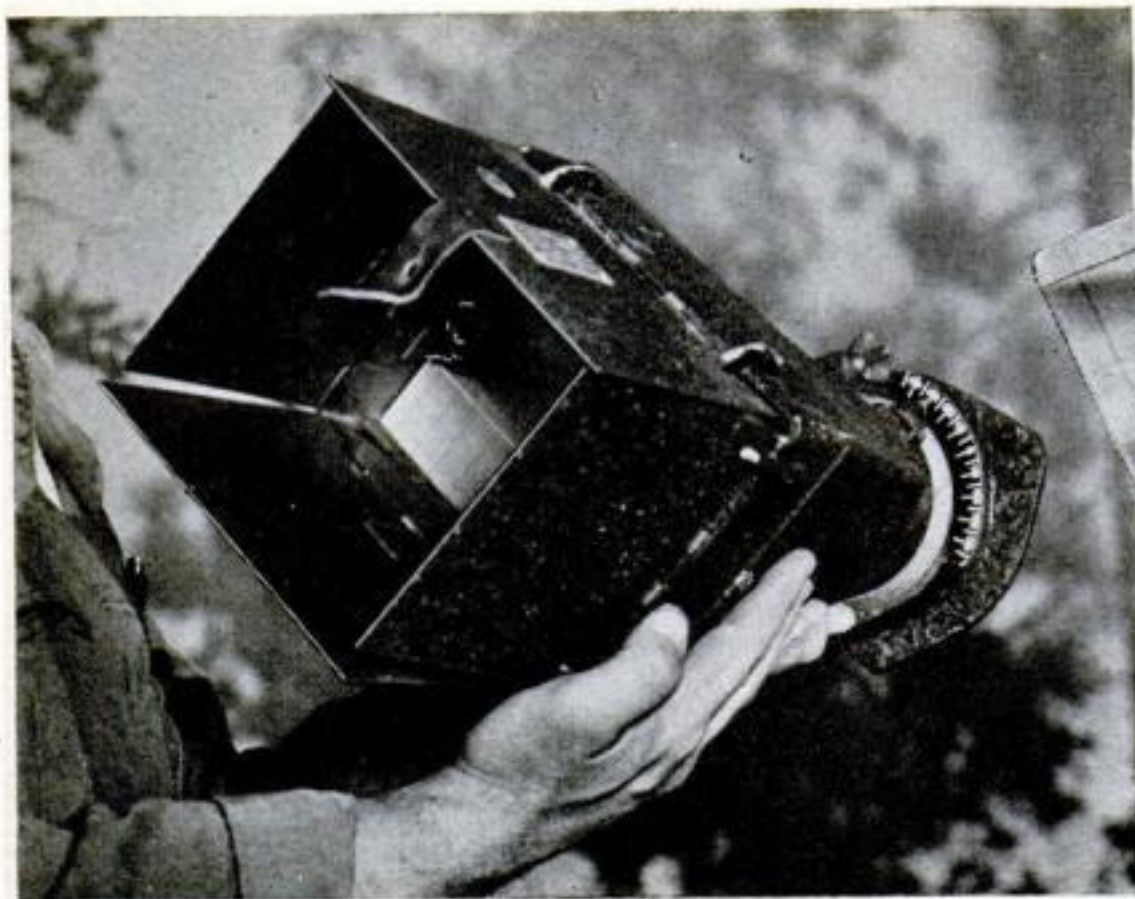
Observation outfits had been the chore boys of the air force. The observer's work was of the utmost importance. It called for intense specialization, technical knowledge, and mathematical precision. But it hadn't a bit of glamor about it. An observer was the Army flyer who was *not* part of the

swashbuckling GHQ striking power. An observer could never be an ace. Once in battle he would take plenty of risk, get none of the credit, and never be in on the kill.

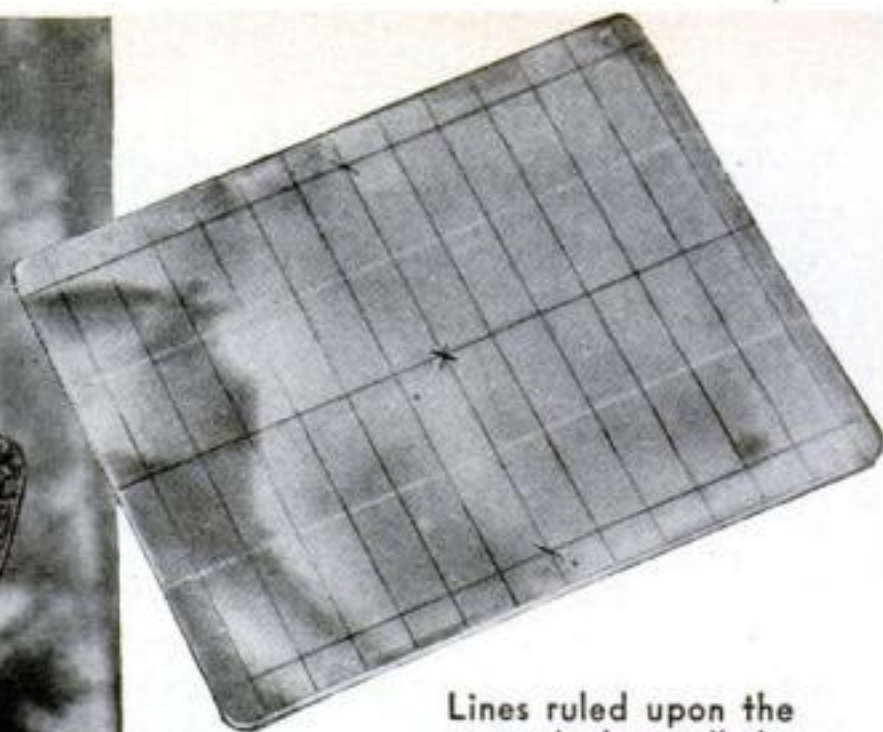
Meanwhile he floated around in a bumbling old-lady type of plane with a goldfish-bowl canopy, a popgun armament, and a top speed of 175 miles an hour, telling the field artillery whether it was on or off the target. With present-day speeds of fighter planes, a fellow might as well be flying a captive

And here is the P-43 with an oblique-mounted camera, as used by the British in the Spitfire. This plane can get a vertical shot by banking as it swoops down out of the clouds. When he uses a one-seater fighter plane, the air observer has to be pilot and gunner, and uses an automatic camera with hand-operated release

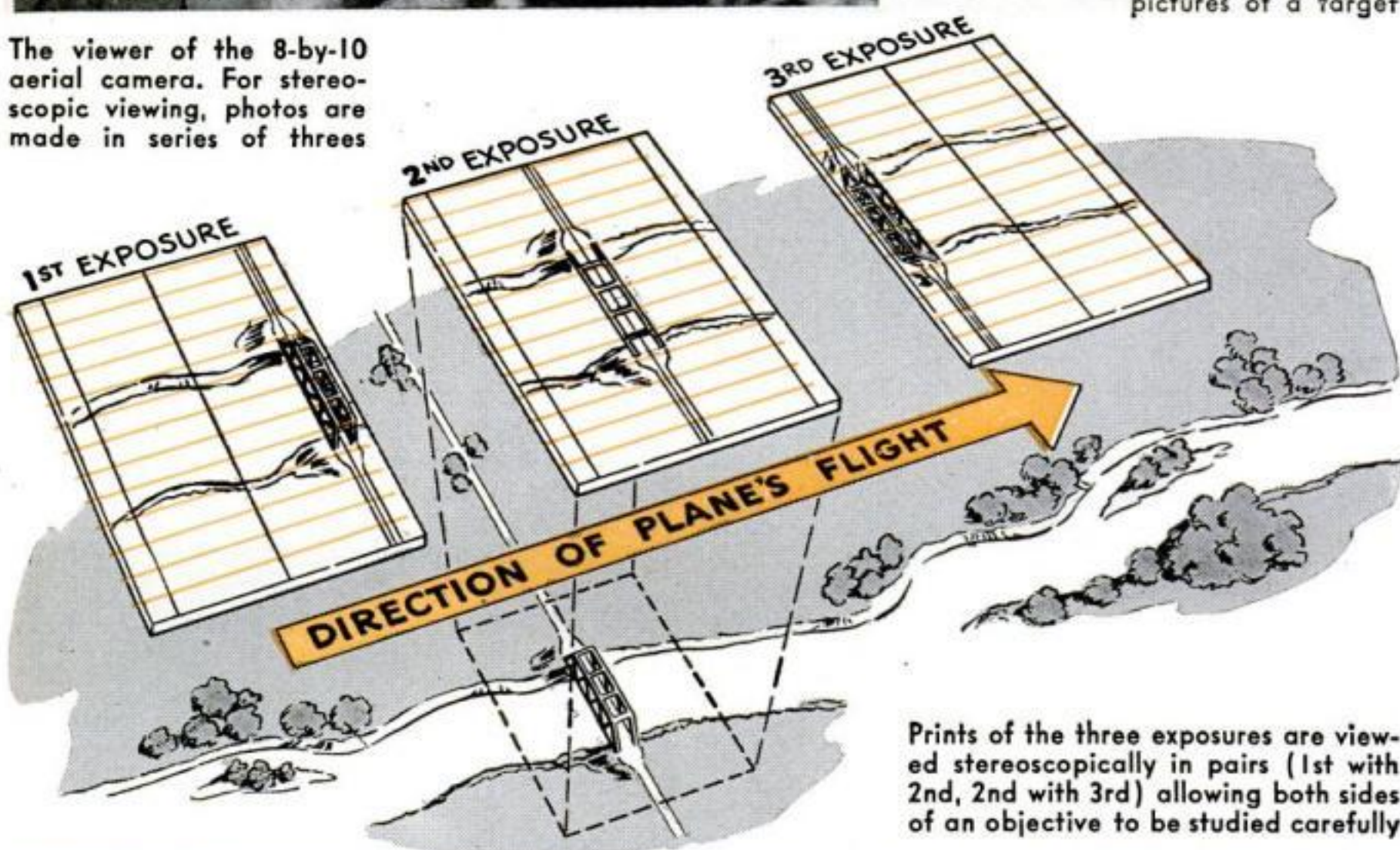




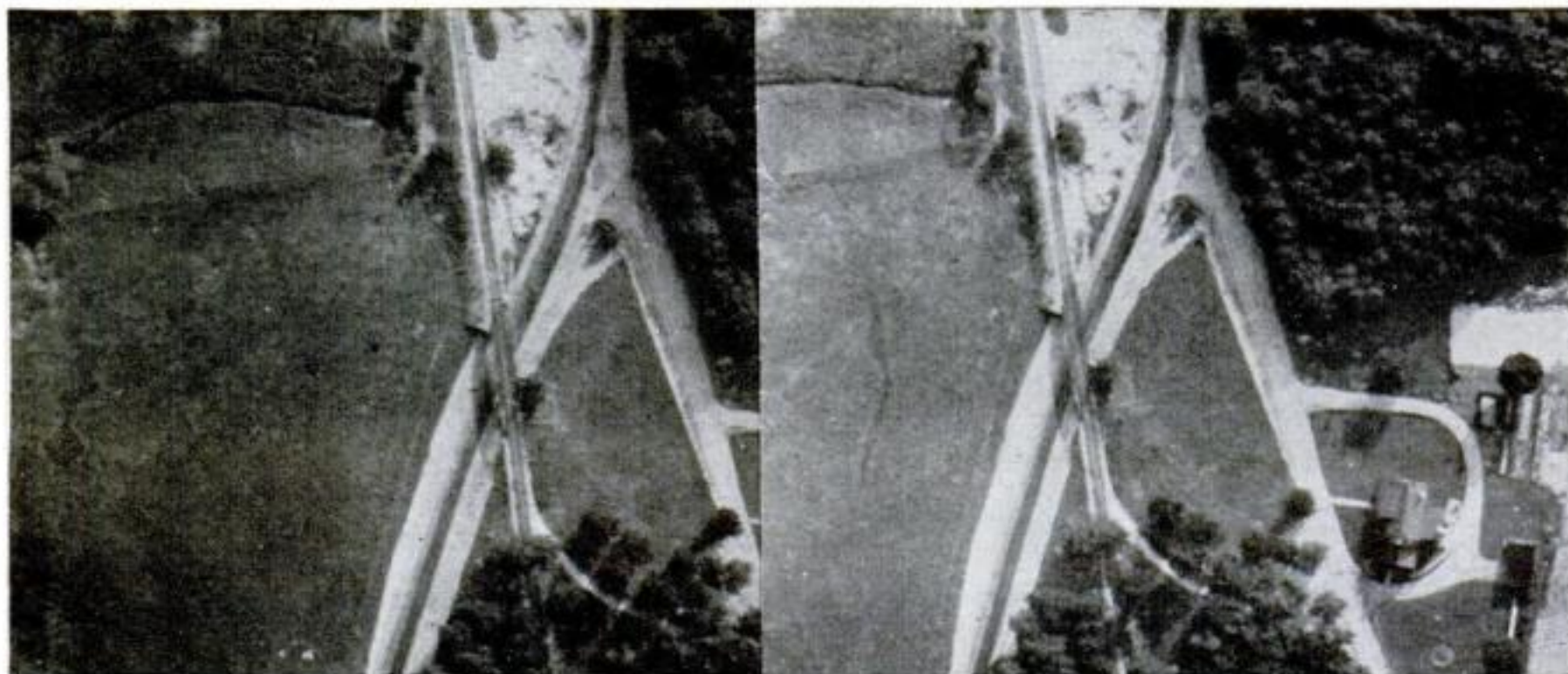
The viewer of the 8-by-10 aerial camera. For stereoscopic viewing, photos are made in series of threes



Lines ruled upon the ground glass tell the observer when to snap the shutter for three overlapping pictures of a target



Prints of the three exposures are viewed stereoscopically in pairs (1st with 2nd, 2nd with 3rd) allowing both sides of an objective to be studied carefully



balloon, for all the security it gave him.

But that ended with the first bomb on Pearl Harbor. Today no plane is too hot for an observer. And when faster planes are built, observers will fly them too. American observers have been getting their new methods ready ever since they were developed out of British experience. All they needed was a little more training with their new ships to be ready to fly right into the jaws of the enemy to get the vital information without which there can be no victory.

This article about new observation methods begins with Howie Olsen, not through any intention to glorify him above any of the hundreds of other fine young fellows who will be doing a similar job, but because it's a good idea to get these things down to human terms. War communiqués are cold-blooded things, but they cover the exploits of hot-blooded young men.

When you hear that a fleet of American bombers has blasted the living daylights out of the Japs or Nazis at some far-distant

point, just remember that some fellow like Howie was there first—perhaps several times—to pick out the objective, to make photographs which would show the value of attacking it.

Maybe he flew in the nose of a light twin-engined bomber, with a pilot and two gunners behind. Quite likely he flew over enemy territory all by himself, with only his own speed and marksmanship to protect him—in a P-38 pursuit ship high in the stratosphere, diving down below the clouds, running off a series of photographs, and zooming upward again to high-tail for home.

Going into the Army was about the last thing Howie Olsen wanted to do back in 1940. He had finished the course in commerce at the University of Wisconsin in 1939 and was an up-and-at-'em young business man of Madison. He had worked his way through college running a filling station; now he had two filling stations and also a good job with a firm of public accountants, traveling around the Middle West

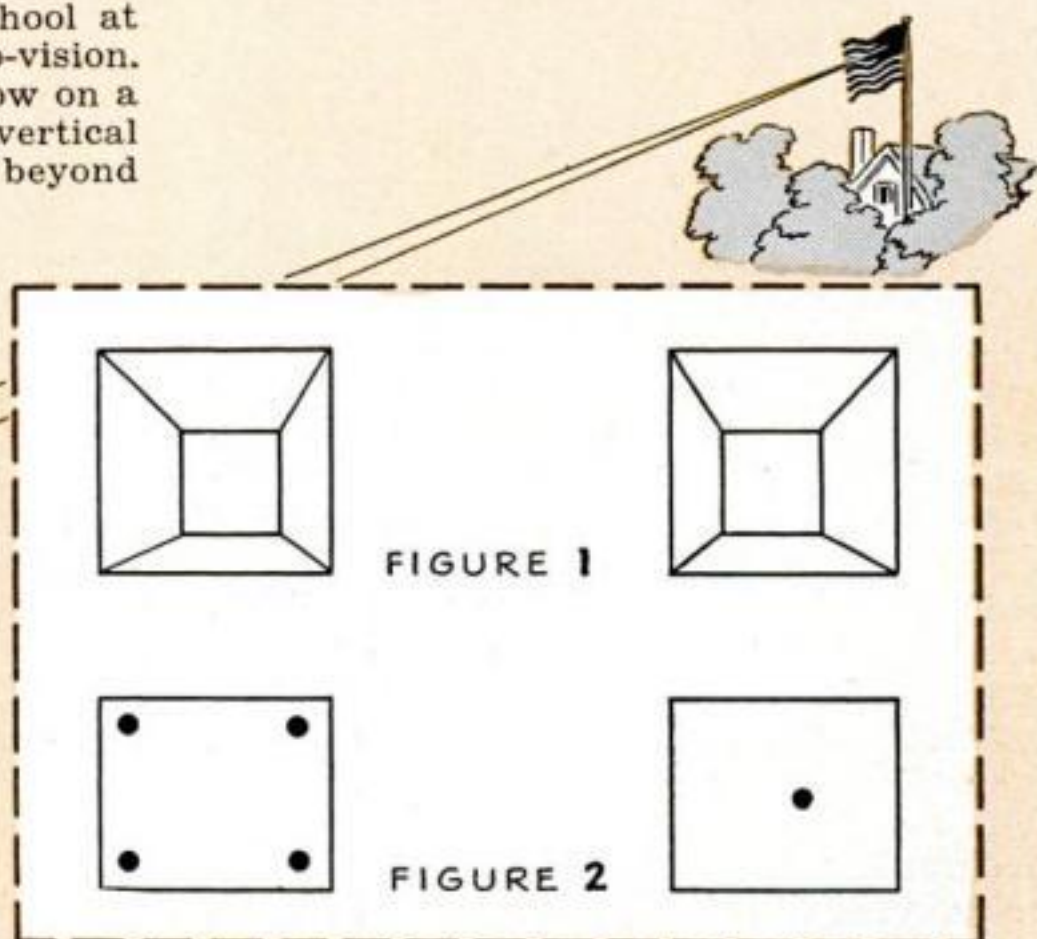
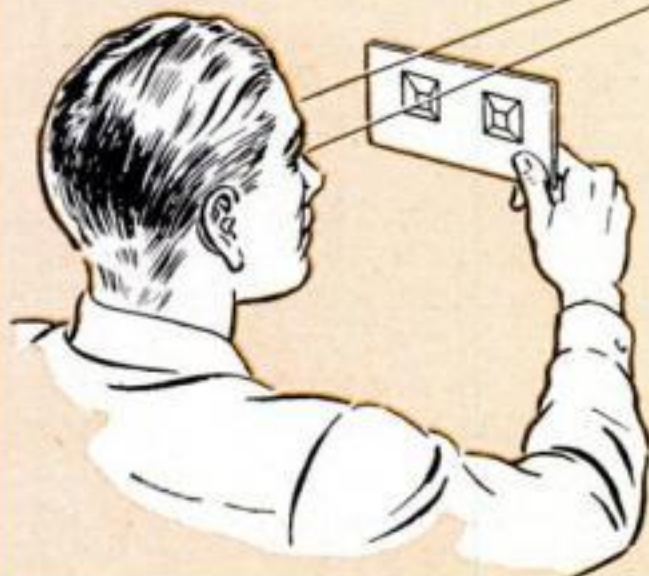
Do You Have Stereo-Vision? Give Yourself This Army Test

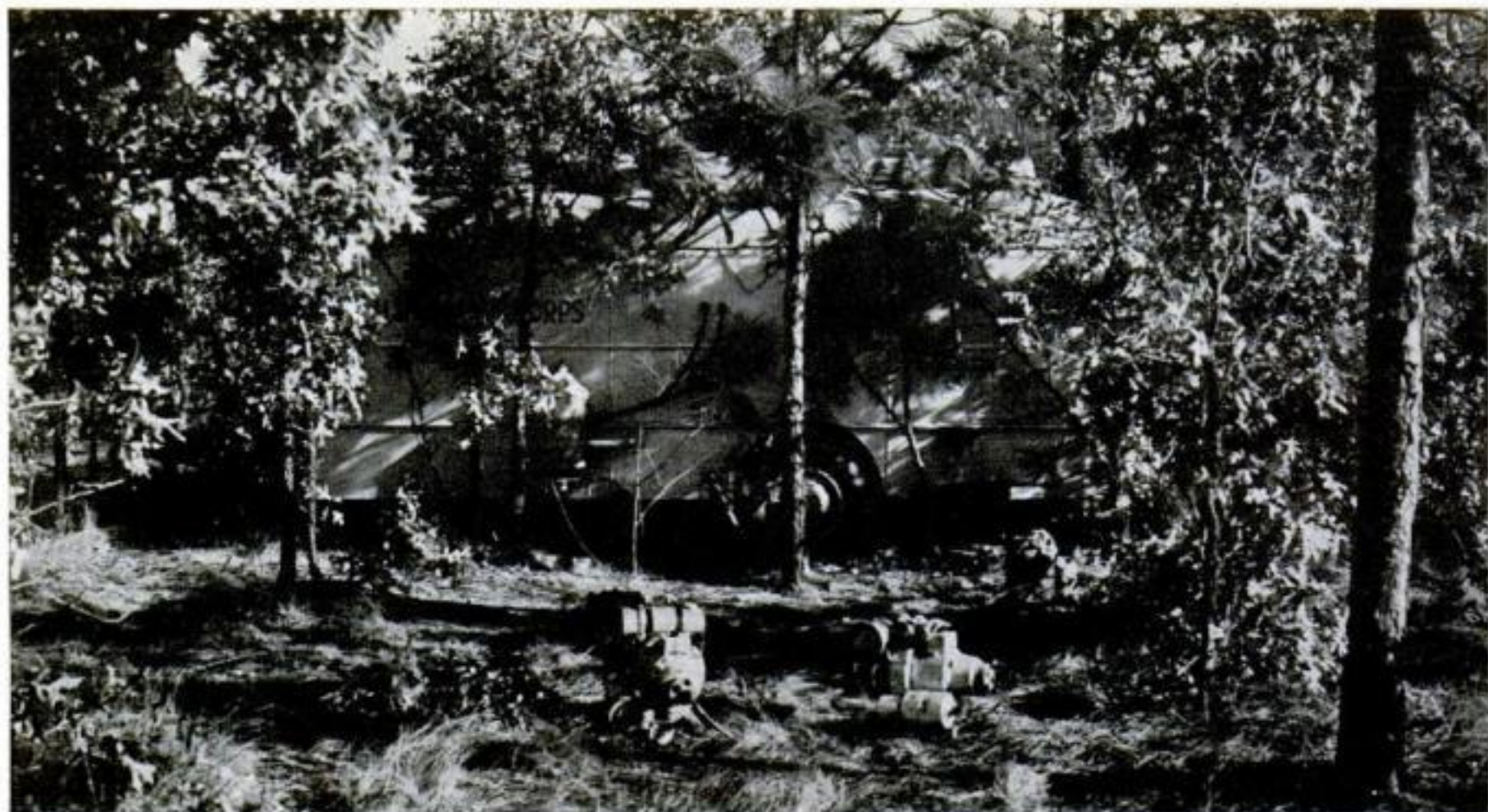
STEREOSCOPIC interpretation of aerial photographs is one of the newest things in air observation. When viewed this way, three-strip overlapping pictures reveal tanks, guns, and other military objectives in relief, contrasted with natural and artificial cover which might hide them in an ordinary two-dimensional view. To speed the study of such photographs, the Army is training men to use stereoscopic vision with the unaided eyes. Here is a simple exercise worked out by the Engineer School at Fort Belvoir, Va., to develop stereo-vision.

Make a copy of the figures below on a card. Then, holding the card vertical about a foot from your face, look beyond

it at some distant object for about 30 seconds. Without changing the focus of your eyes, move the card in front of them and look at the upper figures. You will probably see three truncated prisms, with the center one showing the effect of relief. Similarly, try shifting your eyes from the distant object to the squares and dots. After practice you should see a third square with one dot in the center and one at each corner.

This simple test will show whether you have stereoscopic vision, used in interpreting three-strip photos





A trailer darkroom turns out prints in 55 minutes after films hit the ground. Note portable power units



This tentlike lean-to erected beside the trailer provides additional working space. The mobile photographic unit follows the planes to advanced bases

auditing the books of business corporations.

He wasn't interested in the military life, but when he felt his number coming up, late in 1940, he began to look around for a spot. About this time Maj. Paul D. Meyers was called back from New York to Wisconsin by Governor Heil to organize an air-observation squadron for the Wisconsin National Guard. Paulie Meyers was a Wisconsin football hero back in the days before and after the last

war. Howie had been a football and basketball man at Madison too, and Meyers asked him to join up. Howie jumped at the chance. So did a lot of other fellows. Paulie Meyers was able to pick his 115 enlisted men from 1,500 applicants who were eager to serve under him. The 126th Squadron was green when called to active duty at Fort Dix, N. J., last June, but it had all the makings of a crack outfit.

As a newly commissioned observer lieutenant—not a pilot—Olsen soon found that he had an intensive course of studies cut out for him. To be an efficient observer, he had to know photography; he had to be able to handle radio, either key or voice. (There's a lot of technique in talking through a little voice radio, and making yourself understood.) He had to master navigation, to know exactly where he saw activity or took a photograph. He had to study meteorology and practice gunnery. On a military mission, the observer would be in charge of everything except the actual piloting of the plane, and he had to know his job from the roots up.

Above all, he had to understand what he was seeing when he looked down from a plane on the crazy-quilt landscape moving below, not only to recognize it but also to understand it in terms of military tactics and strategy. He must know the significance of what he saw, and what to report back by radio to his base. That was new to Olsen, but as to understanding the landscape he had a head start. He had flown planes himself for 350 hours while he was in col-

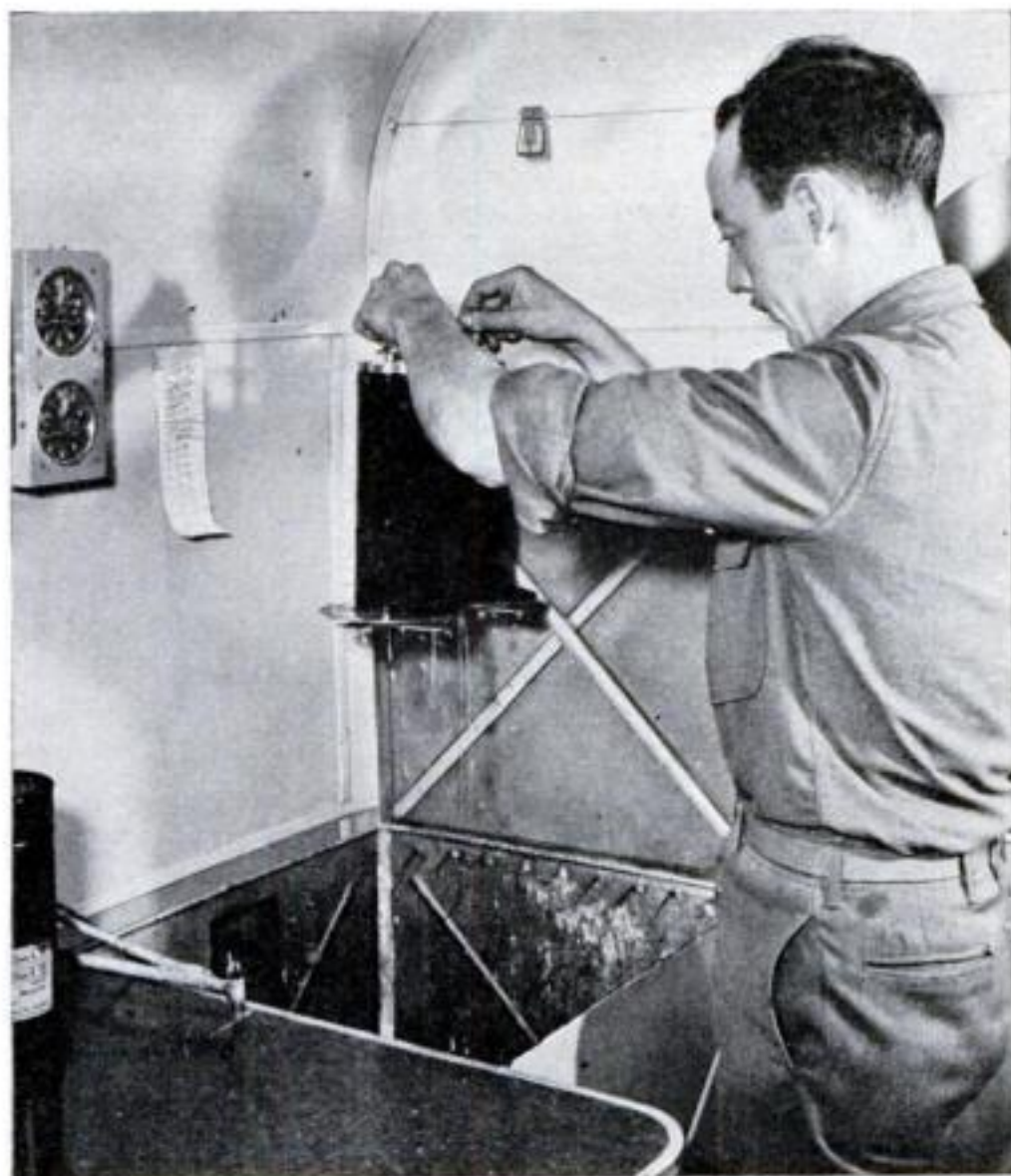
lege. His roommate had been manager of the local airport, and Howie had made the most of it.

It was only because he didn't yearn to spend years in the Army that he hadn't gone out for training as a flying cadet. But now, as he began to learn the significance of the new developments in observation, he began to reconsider. When I last saw him, just before the declaration of war, he was planning to put in for Kelly Field, so that he could combine his training as observer and pilot. It seems quite likely that he will become an observer-pilot. Certainly we are going to need plenty of them.

Observation ideas were knocked galley-west in the first days of active fighting in Europe. Britain, like the United States, had developed a special type of slow, easygoing

plane for observation, built to give plenty of opportunity to look around. Thought was dominated by the World War concept of a stabilized front, with planes used to observe the effectiveness of artillery fire and events close to the battle line. But promptly the British found that in a quiet sector of fighting, their mortality among observers ran at the rate of *60 percent a week*. They had to recruit and train a whole new crop of observers, and put them in a new type of ship. That ship was a Spitfire, stripped down so it could carry plenty of fuel, and equipped with a fixed, automatic camera. The camera could see and retain far more informing facts than could a speeding flyer. And back at the bases, ingenious new methods were developed to interpret the pictures.

The plane used for training by the 126th

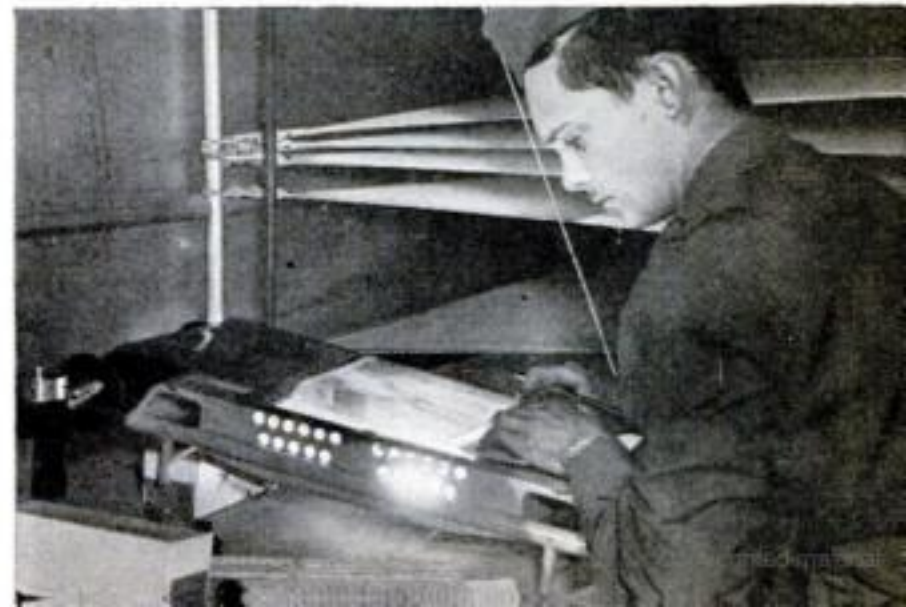
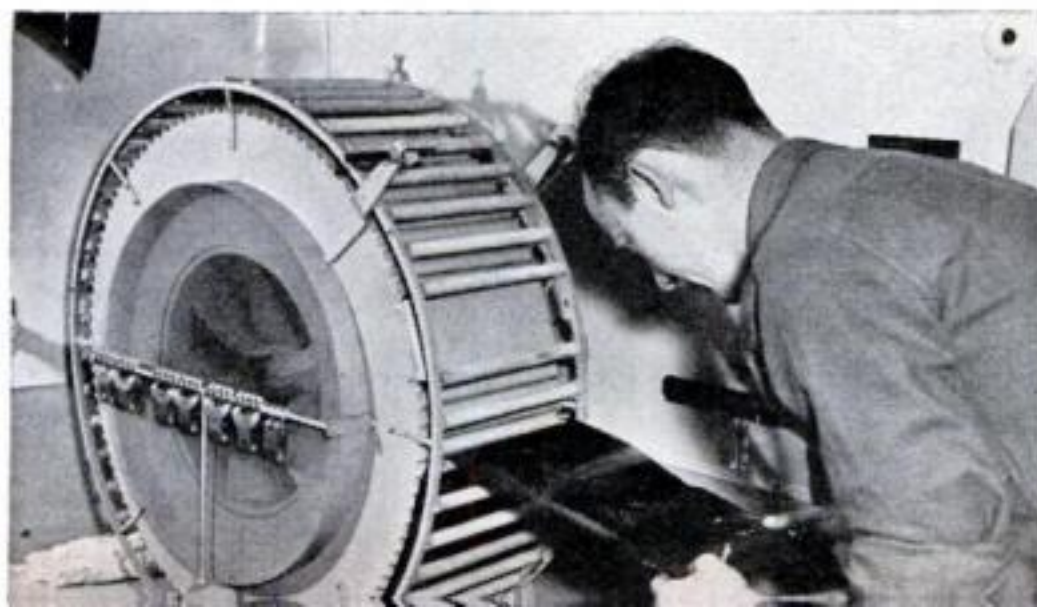


1 Developing the film. The trailer darkroom has all the equipment of a complete studio, geared for high speed



3 In making prints, an elaborate system of controls regulates picture intensity

2 Negatives are dried in a blast of warm air supplied by a centrifugal blower mounted inside this cylinder



4 Prints go to an expert who marks points of reference for comparison with maps



Squadron was of the old observation type, the O-47, a fine, well-mannered ship carrying three men—pilot, observer, and a rear gunner with a .30 caliber machine gun on a revolving mount. It was a fine training ship from which to make photographs, look for armored columns and supply trains on dusty roads, report back by radio.

One day when I was with the 126th during the Carolina maneuvers, one of Olsen's colleagues, Lieutenant Jefferson, discovered an "enemy" airport loaded up with transport planes warming up for a take-off with airborne infantry. He made photographs, tried desperately to get a response from his home-base radio as he broadcast the news. Then a trio of Red army pursuits dived at him, and he was "shot down." He came back to his base with his theoretically nonexistent picture, thinking his mission had failed. But then he heard that his message had got through. Blue bombers had dashed in and "annihilated" the enemy force.

The significant thing about this little incident was that Jefferson was "shot down." In just a few days of operations in a quiet part of the Carolina front, with only one plane going on a mission at a time, practically the whole flying personnel was "shot down" at least once. That would probably be 100-percent mortality per week, but of



Finished pictures are placed in a canvas bag with a long, kitelike tail and given to the pilot of a "grasshopper" liaison plane for delivery to officers who will study them and report any findings that require prompt action by combat units

course no such thing will be permitted.

All idea of using the O-47's in actual battle, of course, had long been discarded. The 126th was expecting soon to be equipped with A-20's. The A-20A is a light

bomber, otherwise known as the DB-7, the same plane which the British equip with heavy guns and transform into a night fighter called the Havoc. The Havoc has shot down more Nazi bombers at night than any other plane, and has been more effectively used by the British than any other American ship. That was good enough reason why the 126th did not yet have them.

The A-20A's from the light bombardment squadrons were used for observation missions during maneuvers, however. They made dozens of such flights sneaking along close to the ground at high speed until ready to soar up and take a look, and not one of them was "shot down." With this ship for visual work, and adapted pursuit ships—the P-40, the P-38, and the P-43—for photographic planes, American observers are going to be well equipped.

The increased speed of the observer increases the importance of photography, and newly developed use of the old principle of the stereoscope has multiplied it. In its photographic work the 126th was learning to make pictures in sets of three, overlapping 60 percent. Doing that properly is a matter of figuring out the relationship between speed and altitude, together with the speed of the motor which rolls the 8-by-10 film in the camera. But the pursuit ships being



Swooping low over the place of delivery, the courier drops the bag of prints. The long streamer, trailing down behind the parcel, makes it easy for men on the ground to find. Rushing pictures to commanders is one of the most important jobs that have been found for lightplanes now being used by the Army

fitted for this kind of work, and soon to be in action, are equipped with a fully automatic 5-by-5 camera, carrying 120 exposures, with an intervalometer which can be set to take the triple sets automatically. This camera is being set in some planes vertically, and in some at an angle of 45 degrees. By banking the plane with the

vertical camera an oblique shot can be made, such as is often desired for the perspective it gives. Similarly the plane with the oblique camera can make vertical shots as it banks down suddenly out of the clouds. The British use this type in the Spitfire.

The 126th Squadron's mobile trailer darkroom can finish *(Continued on page 220)*



At headquarters, a technical sergeant scans a set of prints through a stereoscopic viewer. Skillful interpretation of shapes and shadows reveals important targets and defeats the efforts of enemy camouflage

HOW IT IS DONE



STRIKES AND SPARES



Strike! When all ten pins are knocked down with the first ball in a "frame," the player scores a strike. In the high-speed photos below, the ball is heading for the "1-3 pocket"



WHY 16,000,000 AMERICANS HAVE TAKEN TO BOWLING

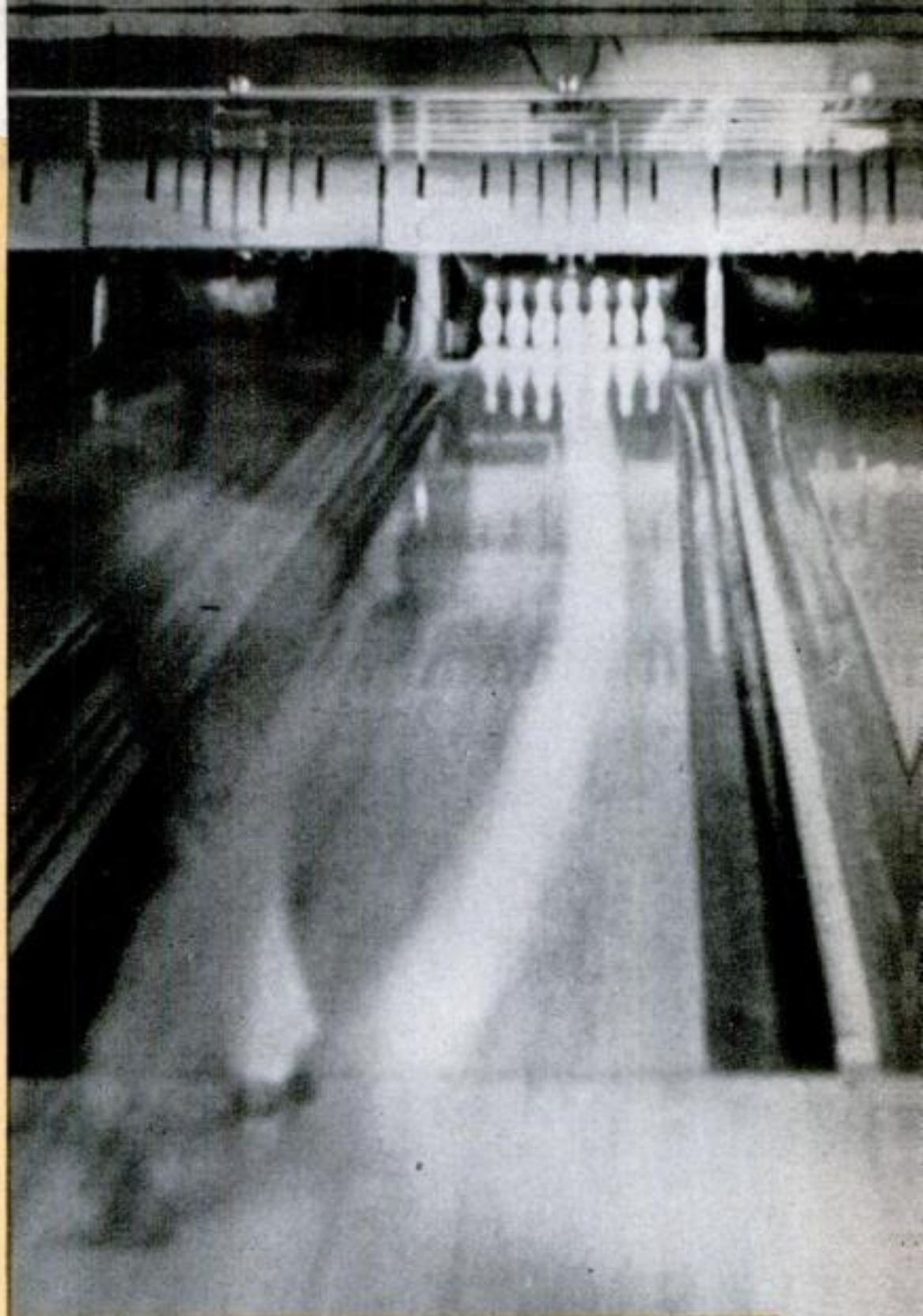
By JOHN E. LODGE

FOR 16,000,000 Americans bowling now holds the fascination it did in 1588 for the British admiral, Sir Francis Drake, who played out a game on Plymouth Hoe before tackling the Spanish Armada, whose tall masts had been seen approaching Britain.

Today bowling not only has more active fans than most other sports, but it has grown to a major industry. Retailers of bowling equipment and operators of bowling alleys estimate that in 1941 American men, women, and children paid out more than \$180,000,000 for the privilege of rolling composition balls at wooden pins.

Bowling came of age here. First recorded in 1299, the game's history twists along a path studded with taboos and restrictions. Henry VIII decreed it might be played only on Christmas Day. In New York, where it was introduced by early Dutch settlers who set up a bowling green in Battery Park, lawmakers later banned the game, stating that it was associated with gambling and "other dissolute practices." Vermont followed suit and bowling appeared to be down for the count. But it didn't stay down.

As the game was then known as ninepins, someone thought of adding another pin; the law was evaded and bowling rolled on. Today the game

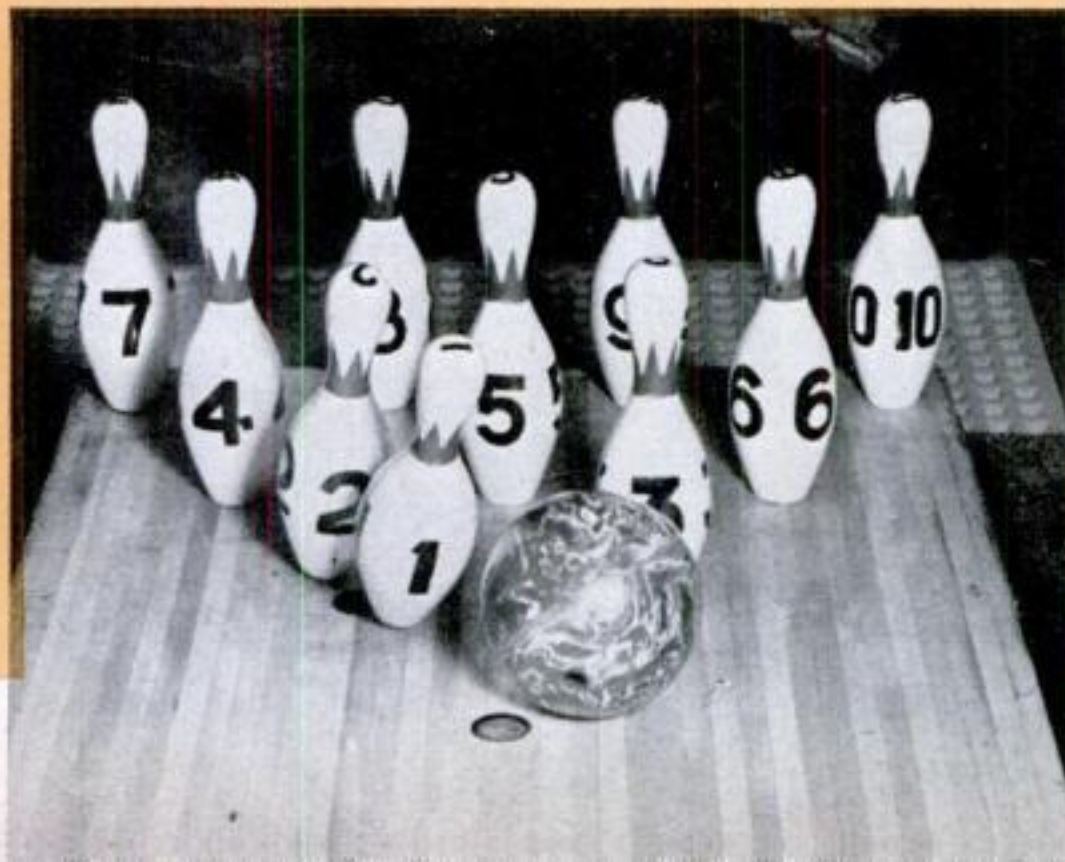


Path of a curved ball down the alley for a perfect hit in the 1-3 pocket. Picture was made with a ball painted white, and with the camera shutter left open

played in more than 5,000 establishments throughout the country is tenpins.

What has this bowling got? Why do enthusiasts in thousands of schools, clubs, industrial leagues, and women's associations snatch

A true hit at this point, just to the right of the No. 1 or head pin, should result in a strike, with flying pins mowing down the ones behind them while the ball accounts for the others for a clean sweep





Footwork

1 Wearing special bowling shoes with a rubber sole on the right and a leather sole on the left, the bowler takes this stance at 12 to 15 feet back of the foul line

every available spare hour to bowl?

Students of the sport answer that besides being great fun, competition, and good exercise, bowling demands skill, without requiring extraordinary physical equipment. And—it's not as easy as it seems. Take a look at the game:

According to rules laid down by the American Bowling Congress, the game of bowling is played with ten wooden pins arranged in triangular formation and a bowling ball, which in circumference may not exceed 27 inches, nor in weight, 16 pounds. Originally the ball had two finger holes, but recently three-fingered balls have been introduced as they tend to provide a better grip and more control.

The pins are placed at one end of the alley, and the game's object is to knock down all ten of them in two rolls. Dropping all the pins with one ball is called a strike; dropping them with two



2 Stepping off with the right foot, he lowers the ball and swings it straight back, keeping the arm and wrist straight and the body balanced. Good footwork is an essential of high-score bowling. These photographs, posed by Joe Norris of Detroit, illustrate the four-step approach recommended for beginners

4 The next step is a smooth glide as the ball comes forward for delivery with the arm and wrist held straight. An important point in delivery is to bend the body only at the hips. The back should be kept straight at all times. Beginners should master footwork and delivery before worrying about hitting pins





3 Here the ball has reached the highest point of the back-swing and the body leans forward for the slide. Now we see why the bowler has different kinds of soles on his two shoes: one is designed to grip the floor, the other to slide. (If you are left-handed, the shoe arrangement given above is reversed)

5 As the bowler reaches the foul line, the ball is released easily, the thumb coming out of its hole first. The hand is lifted sharply for a full follow-through as in billiards, golf, and baseball batting. Footwork, delivery, and follow-through require perfect form and balance to give proper "action" to the ball

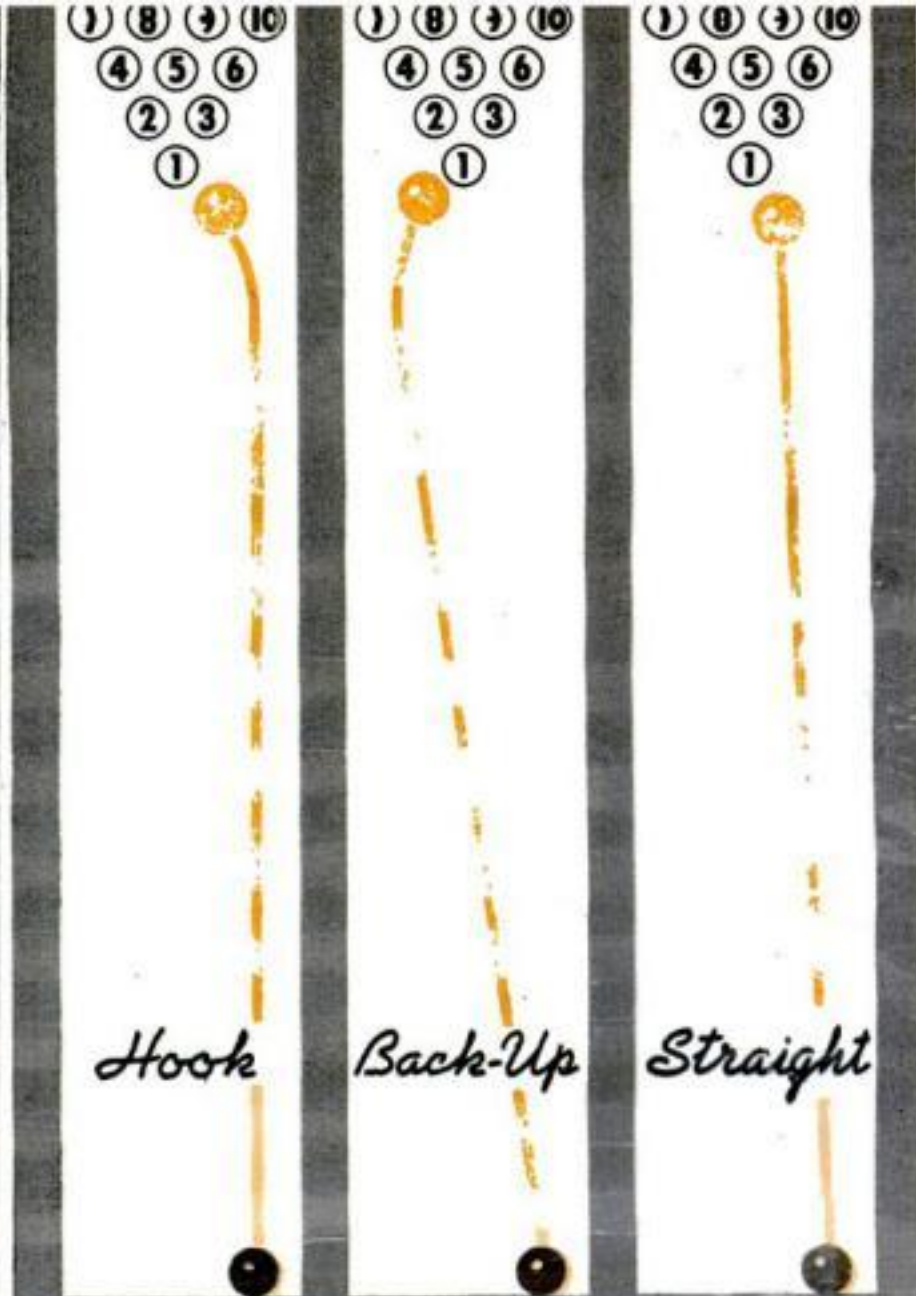
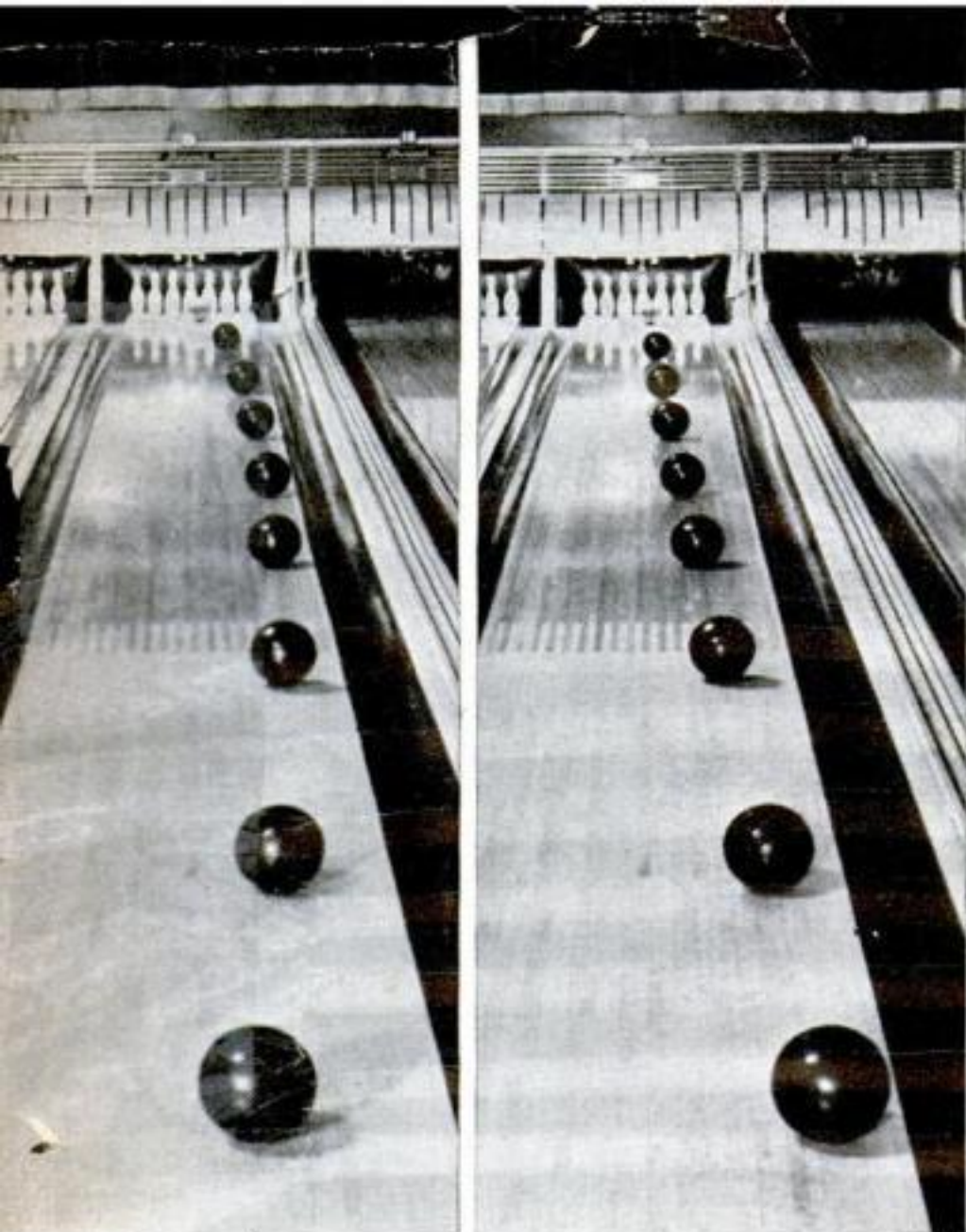
successive balls is a spare. The use of both balls marks an inning or frame and there are ten frames to a game.

A perfect score is 300, and only 2,500 perfect games have been recorded by the American Bowling Congress. One point is scored for each pin knocked down. A spare entitles the bowler to add to the score of that frame the number of pins he knocks down on the next frame's first ball. A strike entitles him to add the total of both his efforts in the next frame. Strikes and spares are cumulative. If a strike or a spare is made in the tenth, or last inning, the bowler is entitled to two extra balls for the former, one for the latter.

Those are the basic rules, but if you want to start right, you had best start from the very beginning—with the right equipment. The most important thing here is to select a ball suitable to your weight, strength, and the size of your fingers. Then, use this and no other! Footwork is important and the right shoes improve footwork. Expert bowlers who are right-handed (there are left-handed experts, too) use foot-

Photos made by R. Smith at Vogue Recreation, Detroit, with cooperation of Brunswick-Balke-Collender





Delivery

There are four kinds of "balls" in bowling. The curve, illustrated in the left-hand photo; the straight, seen in the other photo and one of the drawings; the hook, and the back-up. Each has its advantages, but the straight is easiest to master and is recommended for the beginner

wear with a rubber-soled right shoe and a leather-soled left shoe. One grips, while the other slides.

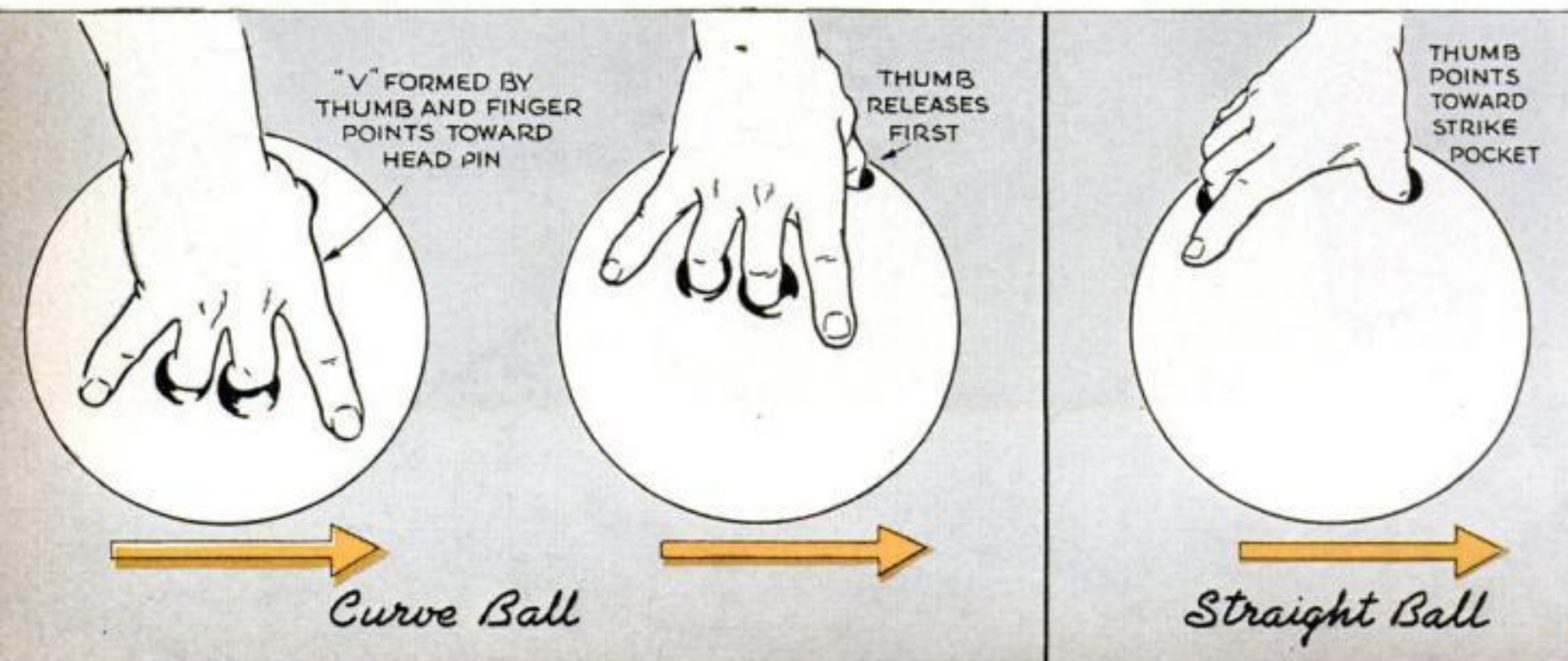
All of which leads to delivery, prime essential of good bowling. If you are a beginner—bowling under 175—take the following position:

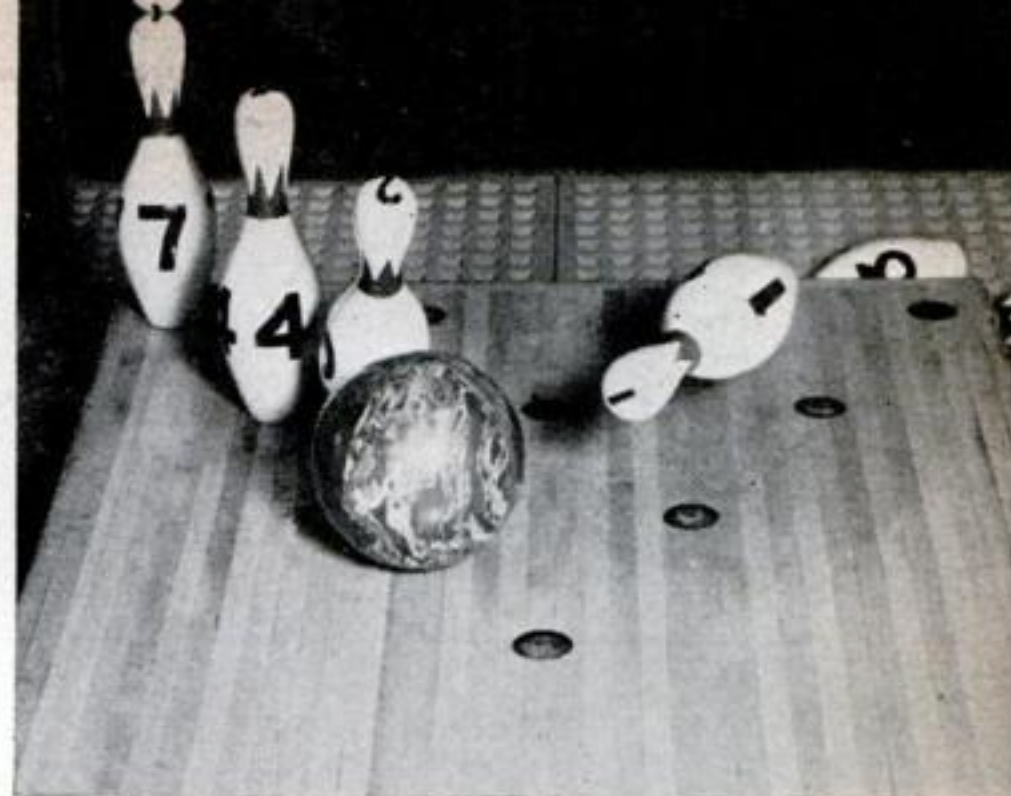
Stand about 12 feet back of the foul line, with both feet planted solidly and close together. Maintain your balance and be ready to start off with the right foot.

Many of bowling's most recent stars advise the four-step delivery as best for beginners. At the first step the ball is brought forward at about chest level. At the second step, it is swung backward. At the third the ball is swung forward, and at the fourth step, released.

Practice your footwork and you'll be ready to learn what to do with the ball after that fourth step. First, experts say, a fault common to beginners must be corrected.

In rolling the curve ball, the ball is gripped as illustrated below and held so that the "V" formed by the thumb and index finger points toward the head pin. The thumb is removed from the ball before the fingers, which are lifted to impart the curve. For the straight ball, thumb points to the head pin





Spare!

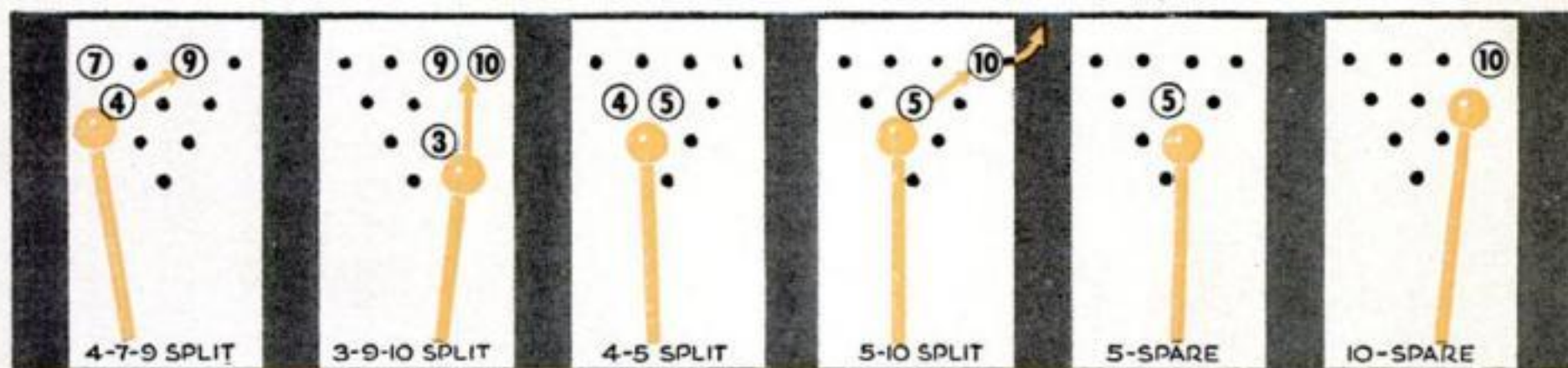
When some of the pins are left to be knocked down with the second ball, it is called a spare. Above is shown a 1-2-4-7 spare and the way that a well-directed ball clears them off. Note how the ball approaches the 1-2 pocket and plows through the pins. No. 2 pin hits No. 4, which in turn accounts for No. 7. Getting the proper angle for spares is important, and bad judgment here can spoil an otherwise good game

That is swinging the ball too far behind the back before starting the forward motion. The ball should be swung back easily and naturally, but never in a sideways curve behind the body. It should be swung straight back and then brought forward in the same imaginary line. The ball should be released just above the floor so that it will start rolling immediately.

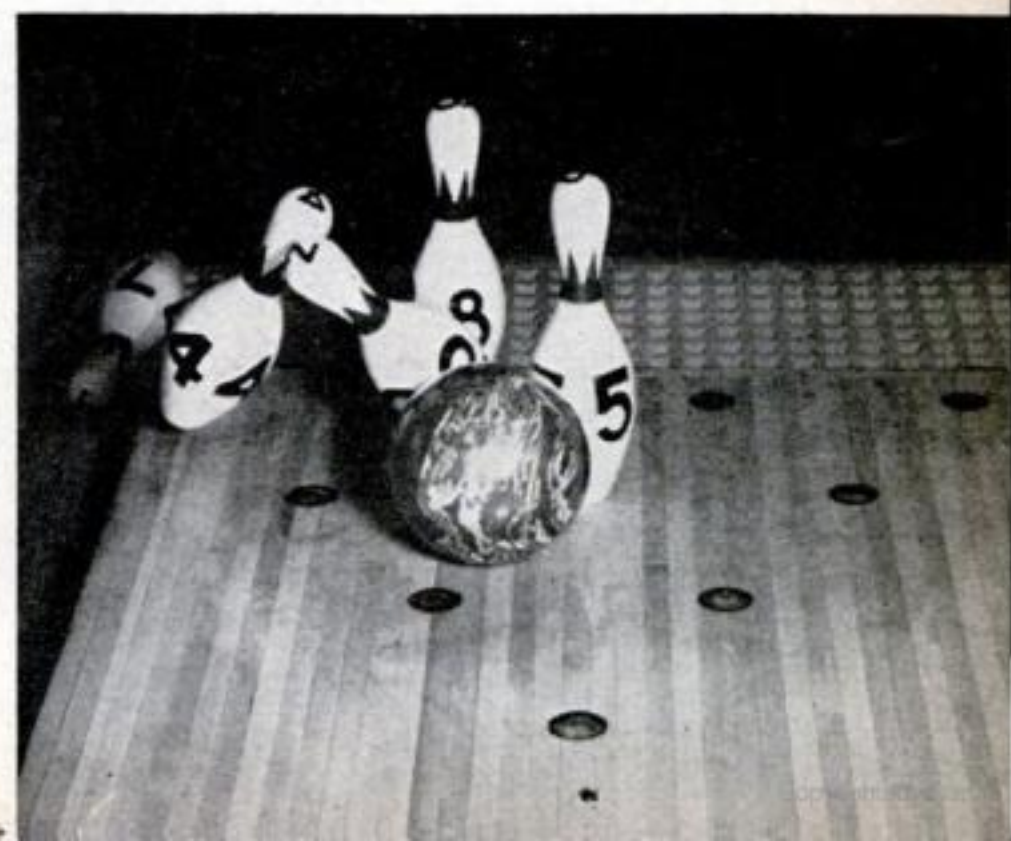
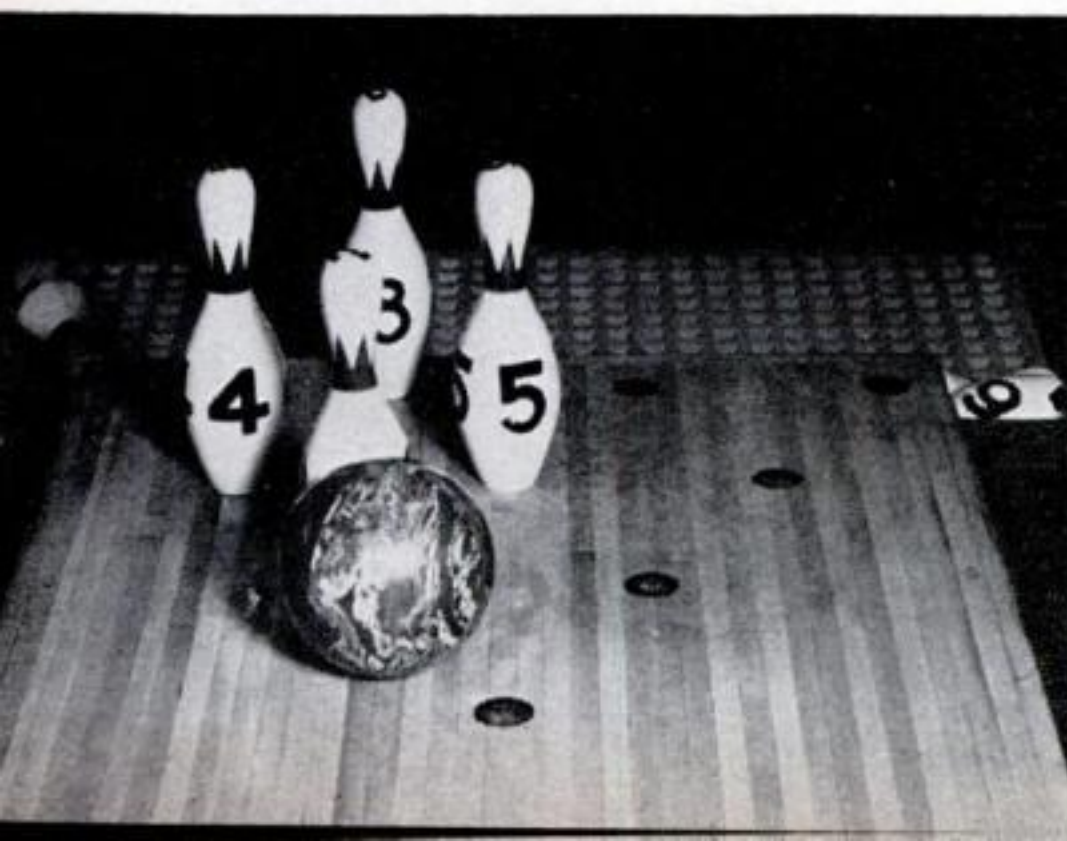
On the question of speed in effective bowling, most experts use an average-fast ball that makes for accuracy and also con-

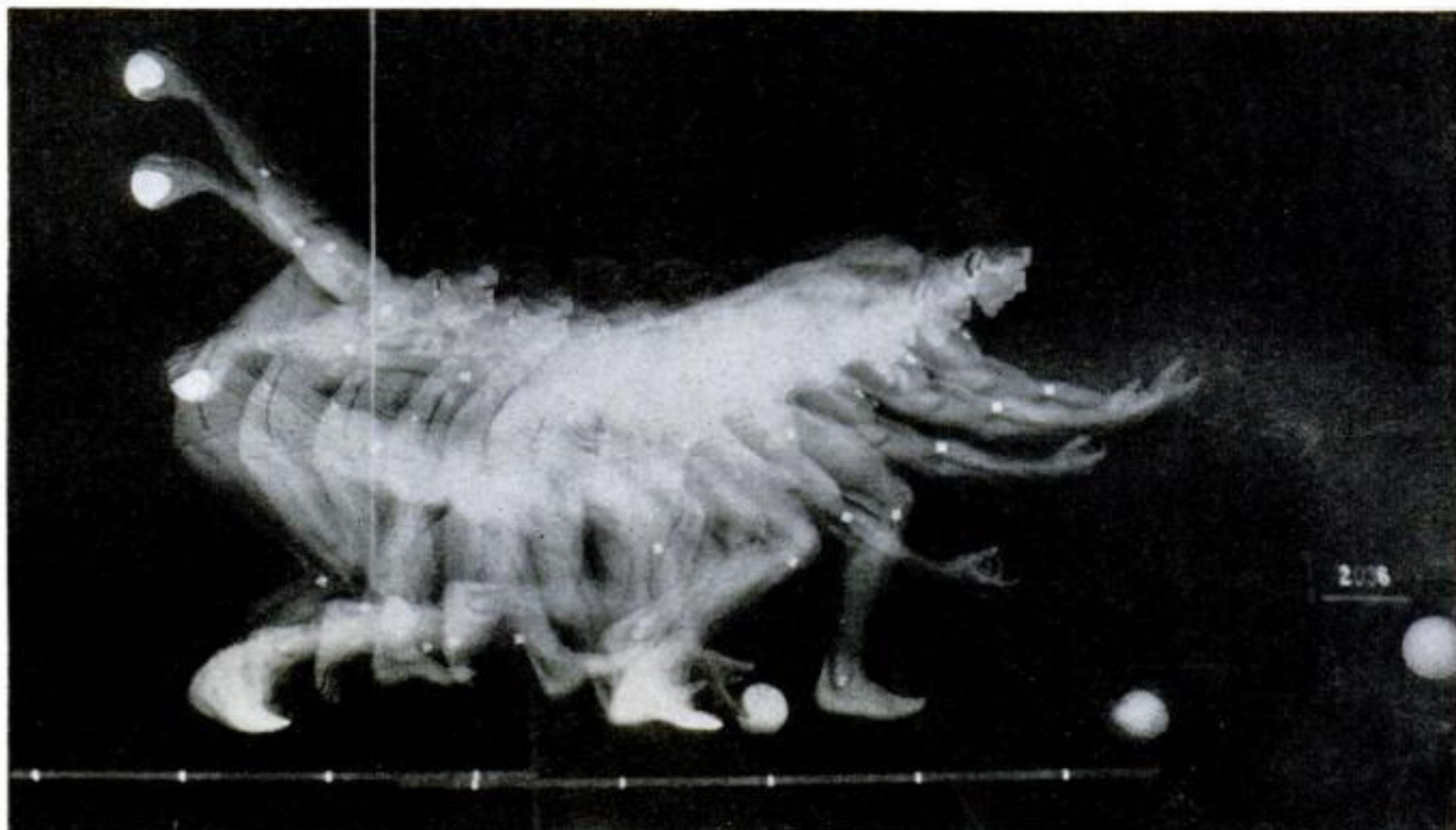
serves strength. Bowling is largely a matter of rhythm and timing. Too fast a ball will split the pins; too slow a ball will sometimes fail, although you score a dead hit, to clean off the pins.

There are four ways to aim the ball at the pins. 1. Keep your eye on the pins, paying no attention to the spot on the alley on which the ball is dropped. 2. Pick a spot on the alley and release the ball on this spot, paying no attention to the pins. 3. Pick a spot on the foul line and another halfway



Various combinations of spares with the recommended angle of approach for each. The expert bowler's rule is to "move away from the pin" and use as much of the width of the alley as possible, instead of rolling from the usual strike position. Below is a successful roll for a 2-4-5-8 spare, showing how it works





© A. G. Spalding & Bros., Inc.

This multiple-exposure photograph, taken at 10 exposures per second, illustrates the windup and release of a bowling ball. Each exposure was for $1/75,000$ of a second duration. Note the path of the ball, various points as indicated by white dots, point of release of the ball, and complete follow-through

down the alley and roll the ball so that it goes over both spots. 4. Pick a spot on which to release the ball and, just before delivering it, lift your eyes to the pins. Most experts favor the last method, but which will prove best in your own case can be determined only by experiment.

At this point beginners are faced with the problem of deciding what type of ball to roll—straight, curve, hooked, or back-up. Each type of delivery has its advantages. Presumably the hooked and curved balls are more effective pin-getters, while the straight ball is easier to control. In most cases, however, the hooked or the curved ball is not recommended until the bowler has acquired a good sense of direction on the alleys.

In the straight delivery the ball should be aimed to the right of the No. 1. or head pin, where a true hit should result in a strike.

However, high-ranking bowlers prefer the curved delivery by 50 to 1. In this delivery the ball follows a curved course down the alley and strikes in the pocket between the No. 1 and No. 3 pins, the latter being placed directly behind and to the right of the head pin. The curve is effected by turning the wrist and the forearm just as the ball is released. A perfect curved ball which crashes into the 1-3 pocket produces a sharp angle, reducing the deflection of the pins and carrying the ball through to achieve the greatest number of strikes.

Don't try too hard for strikes at first. This is the advice of competent bowlers. Try for

spares, and the strikes will take care of themselves.

Besides being good fun and a thrilling sport, bowling affords healthful exercise by stretching and relaxing the muscles rhythmically. It is a pleasant way to attain poise and self-control. Furthermore, by the conditions in which it is played, it teaches sportsmanship and consideration for the rights of others. No wonder that 16,000,000 Americans are flocking to the alleys to try their hand at making strikes and spares!



A "fitting ball" enables the beginner to select an arrangement of holes to fit his fingers and grip



A new rubber product that is saving headaches in many industrial plants: an air hose that won't kink even when it is bent almost double. Busy manufacturers find it a boon wherever compressed air is used to operate tools or for any other purpose

Now They Do It With Rubber

Research Men Juggle Molecules to Find Strange New Uses for an Already Versatile Material in Vital Wartime Industries

By **WALTER E. BURTON**

ONE DAY a fruit breeder saw in a motion picture some webs made by Hollywood spiders—men with electric fans that blow rubber cement into gossamer filaments capable of fooling even a black widow. He wondered if the synthetic spider webs could be blown around pollinated plum blossoms to discourage bees from alighting on them. He took his problem to a group of men in Akron, Ohio, who developed a rubber spider web that will shield blossoms against insect marauders. At the end of ten days this web falls away without disturbing the flowers.

Scientists working in the laboratories of the B. F. Goodrich Company have, by solving such puzzles, proved that rubber is the world's most versatile material. Upon a foundation consisting of a few molecules of carbon and hydrogen they have built thousands of special rubber compounds and created new rubbers and rubberlike materials to meet the growing demands of our fighting forces and the industries that supply them.

Another "self-timer" rubber was developed to help grafters of plants. From it are made rubber bands that have replaced raffia in thousands of nurseries for binding grafts. Once in place, they require no further attention because they relax and fall away when the joint starts to grow.

Research engineers recently announced a rubber that conducts electricity. It is replacing regular rubber wherever static electricity is a problem. Used in belts for driving power tools in the shop and washing machines in the home, it is doing much to reduce a \$3,000,000 yearly fire loss in factories and to prevent shocks to housewives. Made into tires for airplane wheels, it



ARTIFICIAL SPIDER WEBS of rubber blown over cross-pollinated plum blossoms keep meddlesome bees from spoiling things. After ten days, the web will drop off



ROAD ROLLERS shod with rubber are used in Florida for "ironing" limestone roads. Soft rollers compact the stone without grinding it into dust that would blow away



IRONING-BOARD PADS covered with synthetic rubber cut working time by 20 percent. They prevent dissipation

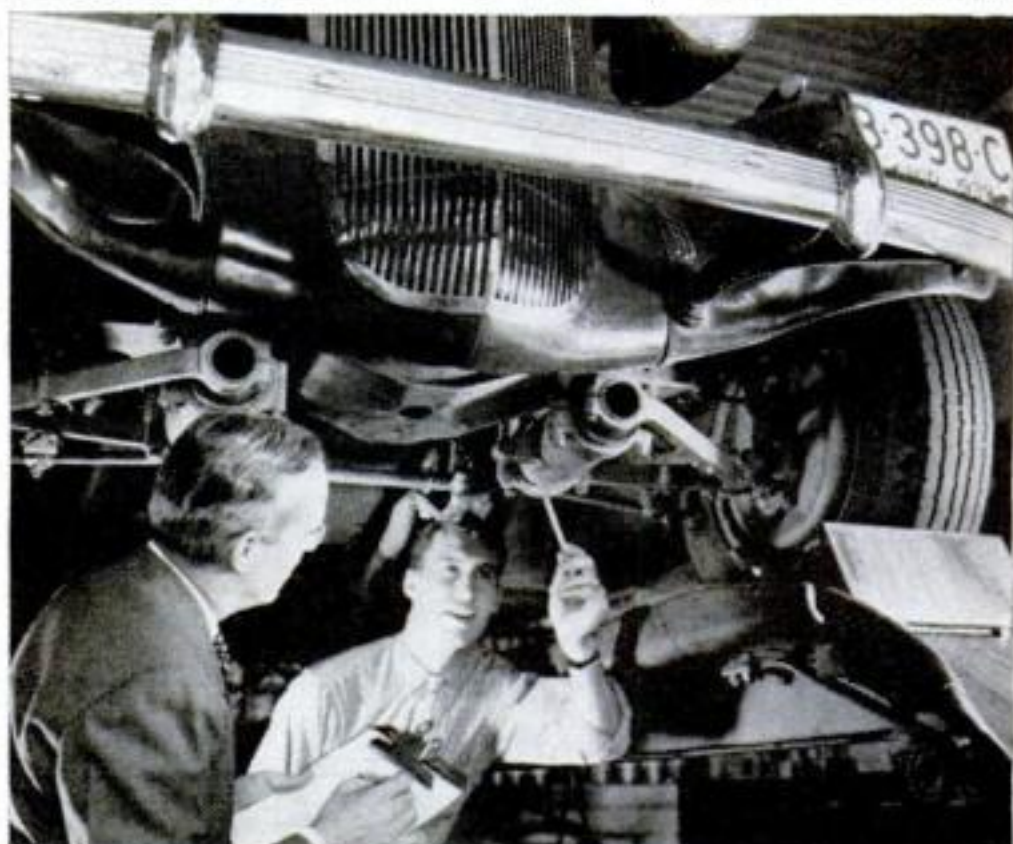
drains off static charges from planes as they are landing. Industrial tires made of the new compound prevent shocks and dangerous sparks in factories. Flooring, sheets, shoe heels and soles, masks, and tubing of this material, used in hospital operating rooms, decrease the hazard of explosions of anesthetic vapors. Conducting rubber is used in gasoline pump hose nozzles to reduce fire hazards at filling stations.

Ever see a rubber sandwich? The meat is a block of rubber and the bun is two steel plates to which the rubber is joined with a grip of 700 lbs. per square inch. Place such a sandwich on edge at each corner of a machine, attach one of the plates to the floor and the other to the machine, and you have an effective barrier against the transmission of vibration. They are used to isolate airplane control panels, radio-station instrument boards, office machines, theater projection machines, sound-truck recording units, and electric motors.

In Florida, limestone roads are prevented from blowing away by ironing them with rubber-wheeled steam rollers that compact the particles without smashing them into dust. Automobiles a few years from now may glide on wheels suspended by rubber "springs" consisting of tubes of resilient rubber welded by a special vulcanizing process to concentric steel tubes.

A man invented a sorting machine to separate dried, wrinkled beans from the good ones used in making "Boston baked." But he was plagued by failure until Goodrich rubber wizards developed a special, highly polished roll that squeezes the bad

AUTOMOBILE SPRINGS. Below is a Goodrich test car equipped with rubber springs. A leading bus manufacturer is planning to adopt rubber springs soon



beans into the discard while the good ones pass by. Windows of buildings being cleaned by acid solutions are protected by rubber films that are painted on the glass and then stripped away after the job is done.

Elastic clothing and surgical supplies have been given a tenfold increase in life by a rubber latex thread so fine that three miles are required to make a pound. One use of such thread is for making automobile seat covers that fit as snugly as the hide on a baseball. A rubberized fabric was found superior to untreated canvas or draper's fabric used on harvesting machines and for the bellowslike diaphragms between railway passenger coaches. Unvulcanized rubber goes in 5,000 lots to a fly-paper manufacturer. The war has caused a boom in tiny tires and cleated belts for toy tanks, scout cars, and other blitz vehicles.

Endless are the novel uses found for rubber belting; and endless are the belts after they are spliced by portable vulcanizers that eliminate necessity of partially dismantling machinery. Synthetic rubber conveyor belts were introduced recently for carrying sludge in disposal plants. The new technique of baking enamel and other finishes with infrared lamps led to the development of a conveyor belt that will withstand the high heat. Rubber conveyor belts that stand up under constant running and baths of fruit juice make it possible to convert hundreds of tons of apples into canned applesauce in a matter of hours.

Copper is conserved for war needs by the substitution of rubber printing plates for making posters, labels, etc. Rubber printing

blocks are also being used widely for producing designs on linoleum and wallpaper.

Rubber putty is used by a manufacturer of caskets for sealing the lids shut. Trouble with ordinary putty in sealing windows of air-conditioned trains was eliminated by substituting rubber, which withstands vibration. Boat builders and ship-repair yards are using the putty to seal joints against both salt water and fresh water.

Spongy rubber, known as "latex foam," is fashioned into kneeling pads for protecting the knees of worshippers in churches while they pray. Pads in the bottoms of deep mail boxes protect letters and packages from damage. By cushioning locomotive seats, latex foam is protecting engineers from bladder and kidney troubles.

Aid to our Allies is speeded by hose of special rubber used to load oil into tankers. It replaces older hose that, softening and roughening under action of oil, would become smaller inside and reduce flow. A hose recently developed for operating hydraulic dump-truck mechanisms at 1,000 pounds per square inch pressure contains 1/5 mile of fine steel wire in every foot.

Potash factories formerly had trouble because metal pipes handling hot brine became clogged with salt crystals. Rubber hose eliminated the trouble because it pulsates and breaks up crystal formations. Onion seed blown through metal pipes in a California plant acted like a sand blast and wore away the pipe elbows. Six-inch rubber hose that replaced the pipe stopped all that. Extruded rubber tubing cut into short lengths and slipped over wire springs was

GASOLINE-HOSE NOZZLE. Danger of explosion from sparks caused by static is reduced by the use of nozzles made of a rubber that conducts electricity



TRANSPARENT FILMS of Koroseal, and fabrics impregnated with the same synthetic, are finding countless new uses in the home and in industry



found to outwear the toughest fiber as bristles for street-sweeper brushes.

Rubberlike synthetics have kept pace with natural rubber. Recently the first improvement in ironing board pads in 50 years was made by perfecting a Koroseal blanket that prevents heat dissipation and actually reflects heat back into the clothing. A method of making film that is transparent and as little as 1/1,000 inch thick has opened another new field for the synthetic. Unlike some films used for packaging, the new material is not affected by exposure to water, oxygen, sunlight, extremes in temperature, or corrosives.

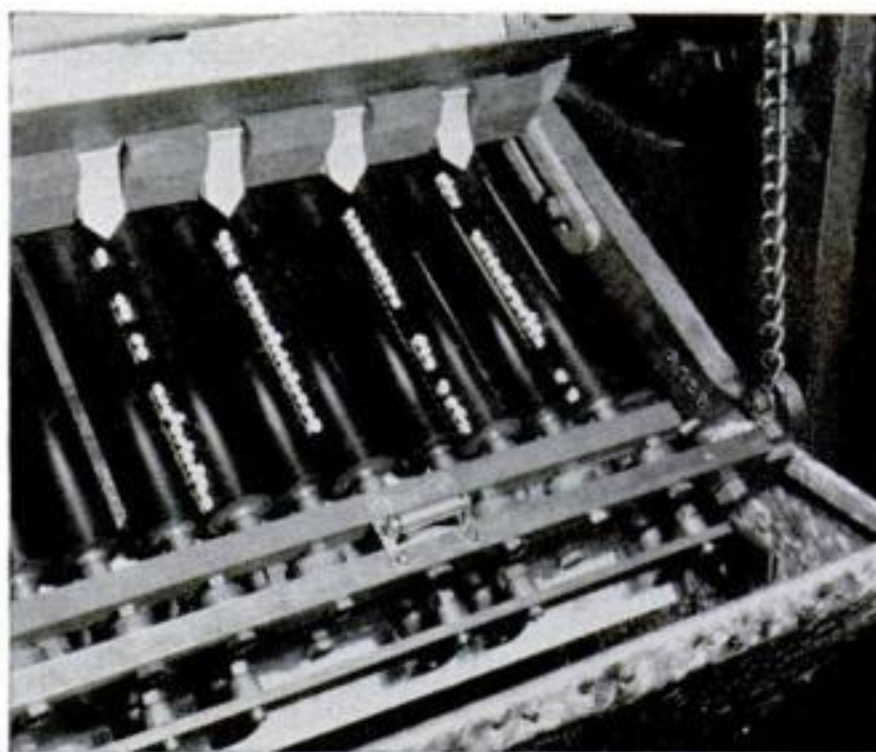
Makers of bombing planes buy 25 and 50-foot lengths of ordinary vacuum-sweeper

hose for use in sucking stray bits of metal, rivets, and other debris from odd corners of the ships before they are flown. High altitude suits for military airmen are coated from boots to helmet with Koroseal to render them air-tight and proof against water, oil, and acids. Lightproof fabric for field photographers' tents is also made with the synthetic.

It is impossible to list all the new uses to which rubber is being put in this whirlwind world, for by the time the ink is dry on the "latest" item, another novel development comes along—a new product like an air hose that can be bent almost double without kinking and is of considerable importance in a busy factory.



NURSERYMEN bind grafted plants with special rubber bands that hold firmly for two to four weeks, then rot and drop off



BEAN SORTER. Rollers of specially developed polished rubber separate dry, wrinkled beans from good ones for baking



PRINTING PLATES of rubber save copper for defense. Left, stripping plate off bakelite matrix cast around type; below, adjusting it on press





Bombers swoop down over Marston Strip, experimental temporary landing field set up in North Carolina

Short-Order Airports

LIGHTWEIGHT STEEL STRIPS AND CHICKEN WIRE
FORM TEMPORARY FIELDS FOR FIGHTER PLANES

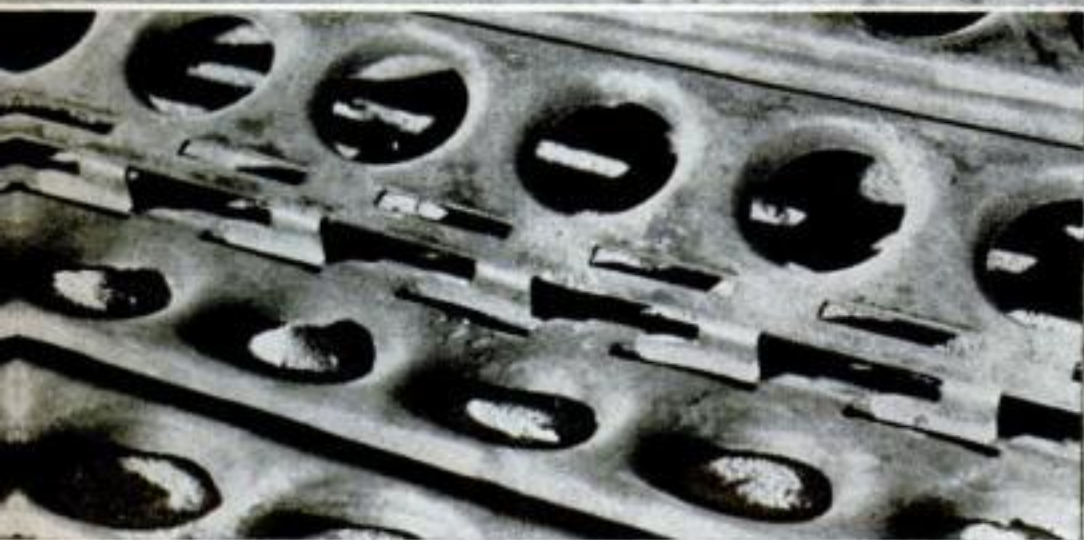


THE FIRST military objective in today's type of battle is to establish local air superiority by obtaining aviation fields close to the actual scene of combat and by destroying the enemy flying fields in that area. Engineers of the Army Air Corps have made a tremendous stride toward this end with the development of a portable steel landing mat which can be installed as a usable military airport in less than two days, and repaired within a few minutes after bombing.

The steel landing field, installed and tested at Marston, N. C., during recent Army maneuvers, was called "the year's greatest achievement in aviation" by Maj. Gen. Henry H. Arnold, head of the Air Corps.

So simple is its construction that it can be easily mass produced; so simple its transporta-

How it looks to an incoming pilot. Steel panels forming the 3,000 by 150-foot runway were laid in 60 hours by three companies of 150 men each working in shifts around the clock, after grading



Perforations in the panels give light weight and provide braking friction without being too hard on tires. Vertical flanges add strength and also bite into the ground to keep the mat from slipping

Photographs by William Morris

One method of binding loose earth or sand at the edges of the runway is to sprinkle it with calcium chloride, which takes moisture from the air



Laying the metal surface. The perforated panels are hooked together at the edges with vertical flanges. When properly engaged with one another and laid out flat, the plates are wedged apart into tight rigidity

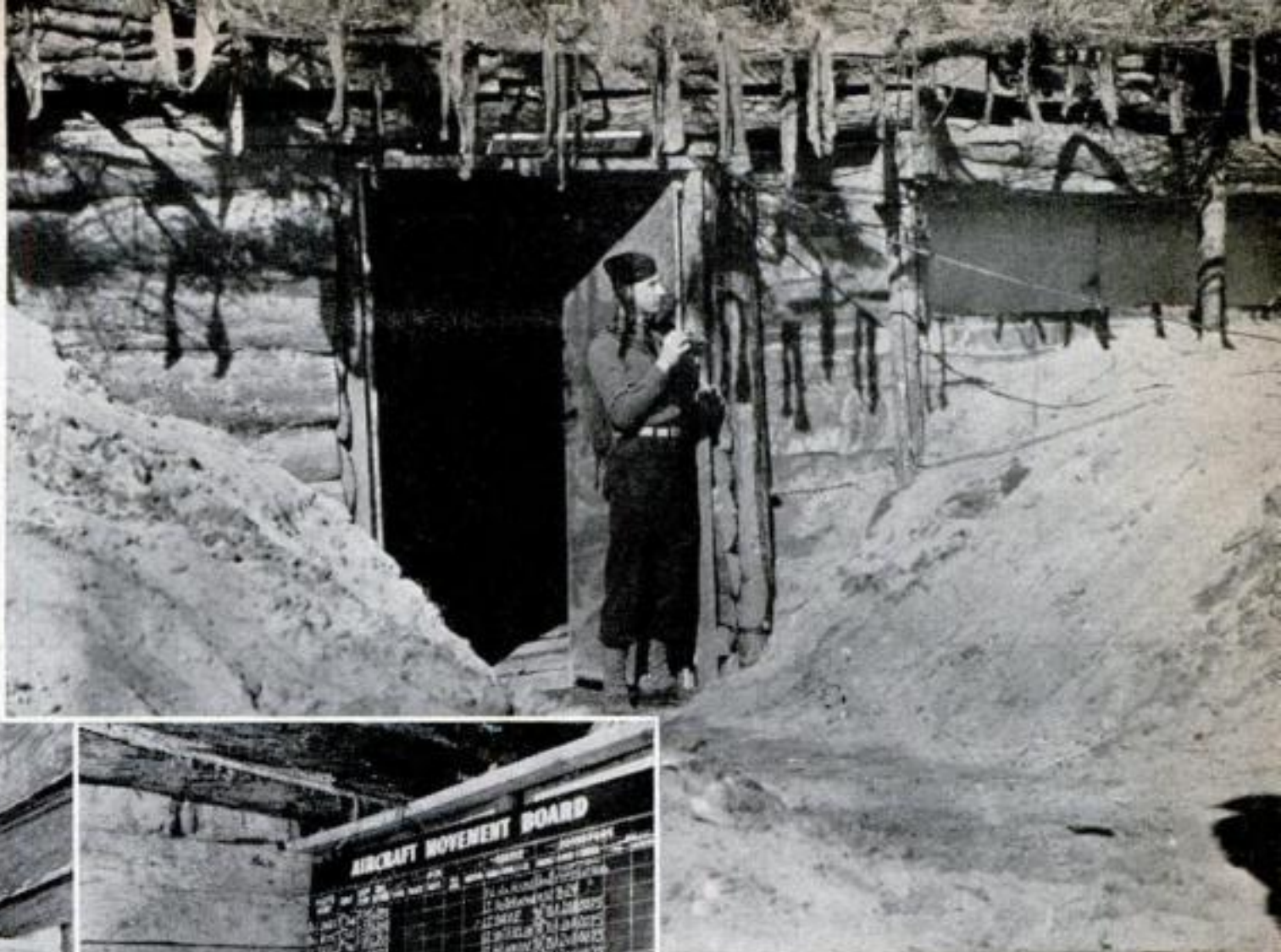
tion and installation that any strip of fairly level ground, such as a South Pacific beach front, can be turned into a hard-surfaced airdrome almost overnight.

This may mean that the American Fleet, advancing against the Japanese, will not have to depend entirely on carrier-borne aircraft. Certainly it means that an American army moving forward in such terrain, for

Chicken wire stretched over the sand forms aprons over which planes are rolled off. This stunt, used by the British in Egypt, makes an efficient roadway



Built into a bank at the side of the strip was the operations office. Walled with pine slabs, it had a covering of sandbags and was camouflaged with boughs. Radio equipment, below, gave direct communication with planes in the air and with headquarters. At the lower right is the operations board on which movements of planes were recorded



the strip to a width of 350 feet. Actual laying of the steel mat took only 60 hours, with three companies of 150 men each working around the clock in eight-hour shifts. On a beach job, with little grading required, it would be quite possible to lay a 2,000-foot strip, 100 feet wide, from which fighter

planes could commence operations, in a good deal less than 24 hours.

instance, as the Libyan desert, can rapidly lay landing fields as it goes, like stepping-stones. The mat weighs only about 1,000 tons. It is transported in small units, such as might easily be lightered ashore for a landing from a supply ship accompanying an expeditionary force.

Marston Strip, as the North Carolina installation was called, was a level steel surface 3,000 feet long and 150 feet wide. It was used by all types of military planes, from the hottest pursuit ships up to the four-engined B-24 bomber.

Its installation by the 2nd Battalion, 21st Engineers (Aviation) required 11 days, but most of this was consumed in grading

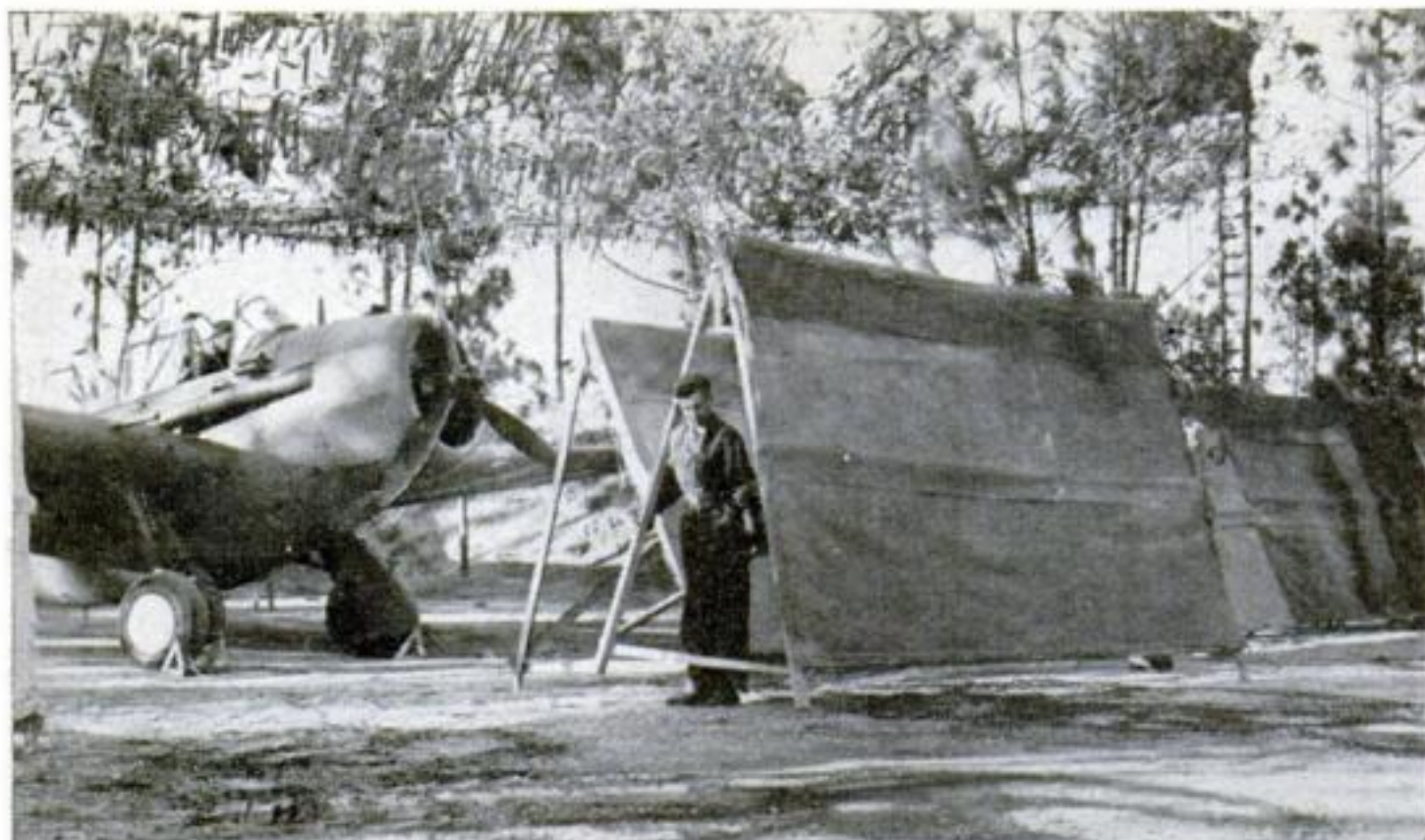
planes could commence operations, in a good deal less than 24 hours.

Military planes need a long runway, but they can use a narrow strip, which does not have to run into the wind. With their high landing speed, they can take off and land in transverse winds which would ground planes of lower wing loading. Since there is no need to wait for concrete to dry, the portable strip can be used by fighter planes even before it is completely laid.

A vast amount of calculation and experi-

Portable landing lights placed alongside the strip are fitted with blackout caps which have adjustable slots for directing narrow beams of light toward one end of the field to guide flyers coming in for a landing. Electric cables can be strung quickly to connect the lights





A repair revetment cut into a bank is screened by cloth panels to restore natural contours. Below, decoys draw off enemy bombers from real targets: A water tank fixed up to look like a fuel truck, and a dummy plane made of wood and canvas with screens that are painted to resemble revetments. Arrow shows effect from the air

ment doubtless went into the designing of this mat, but the end result is of exquisite simplicity. The unit is a panel of light-gauge sheet steel. For lightness and braking friction each panel is perforated. Hooked together, the joints are loose and flexible; but when properly engaged and laid out flat, the plates are wedged apart into a tight rigidity.

In the design of this basic unit, as in all other details, the portable landing field aims at simplicity and adaptability to a wide range of conditions. It can be transported easily either by water or by land, and its installation requires a minimum of skilled labor and heavy equipment that might not always be available at the scene of operations.

Vertical flanges not only contribute to the weight-resisting strength of the plates, but also bite into the ground and keep the mat from slipping under the strain of braking wheels.

In case of a bomb hit, it is possible to fill the crater with dirt and replace the destroyed plates within a few minutes.

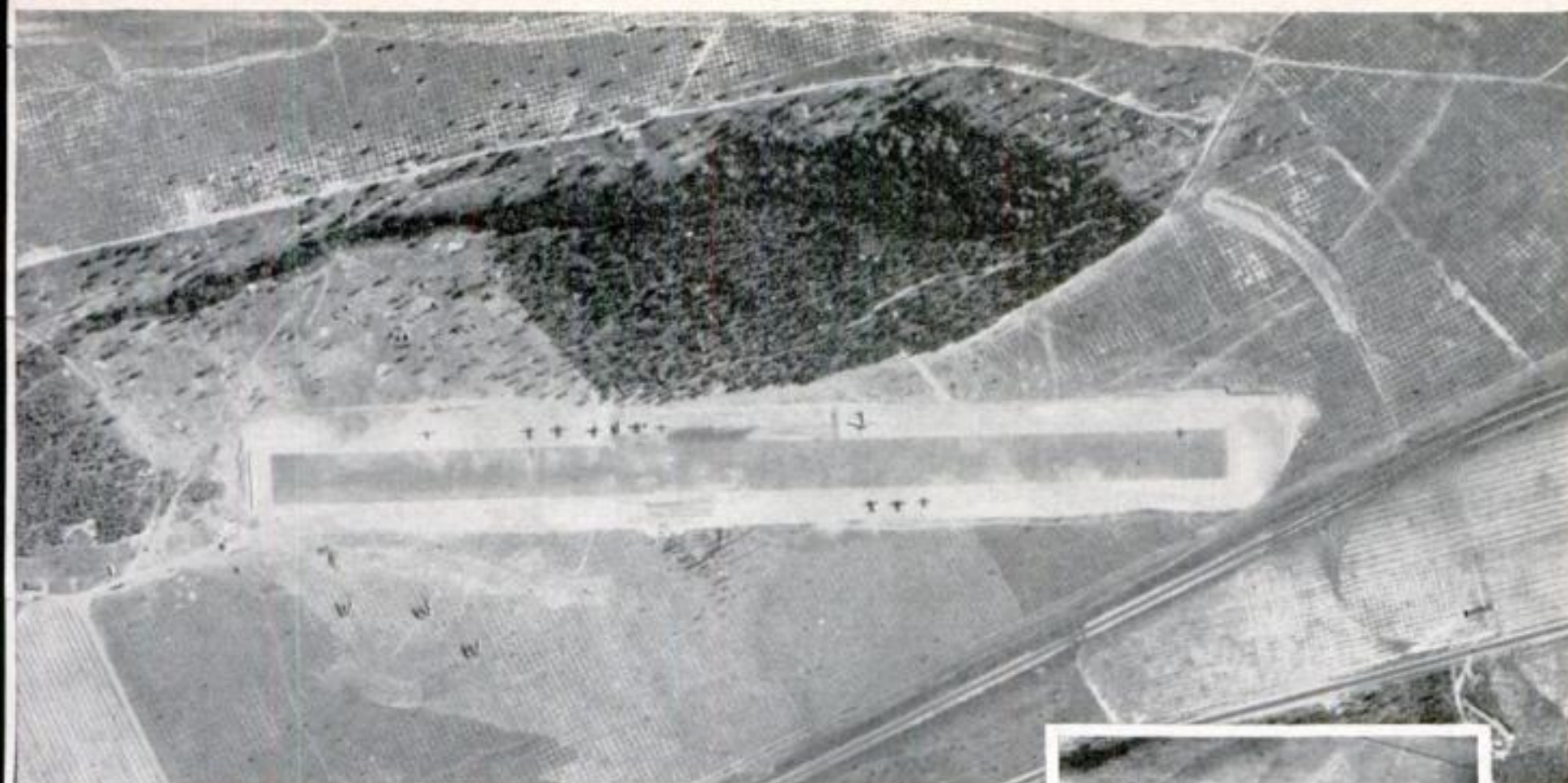
The 2nd Battalion, under Maj. Carron M. Borrer, developed a high degree of teamwork in laying the mat. This work started at the center of the field, while grading machinery was still working toward the ends. Once two rows of plates had been laid across the field, at right angles to the line of traffic, it was possible for each company to work in two gangs of 75 men each, working out from the center. Each gang was divided



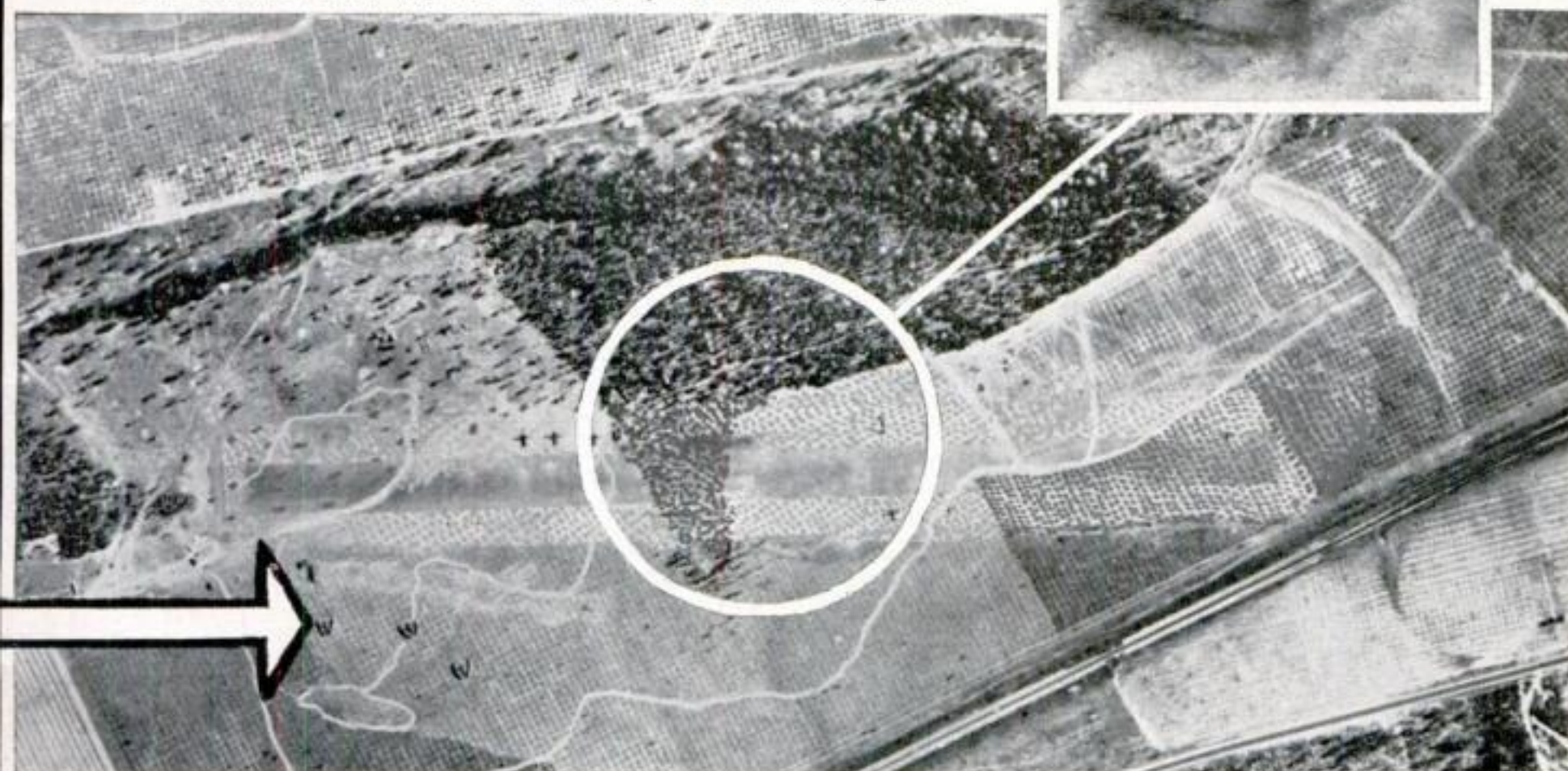
into three crews: one to truck the plates from the 18 flat cars which had brought them to Marston and slip them off on the field at regular intervals; another to engage the plates and lay them; another following up to pound in the clips.

One gang of 75 attained a top speed of four rows across the field—that is, five linear feet—in five minutes.

Once the strip had been laid, most of the engineers departed on other missions, while Company D remained, under Capt. H. G. Woodbury, to continue development of cam-



Skillful camouflage erases the field. Painted circles (inset) on runway and aprons simulate trees to continue the natural outline of the forest, as shown in circle below. Paint spray and bitumen color the rest of the strip to match background



ouflage and sandbag revetments for the storage and servicing of planes, and experiments with soil stabilization on the aprons along the sides of the field.

Along each side of the strip was 100 feet of newly graded sandy soil, which swirled into vast clouds of dust from the prop wash of planes warming up. Various methods of tying down and hardening this soil were tried, each of which might be adapted to operations in a different locality. One section was surfaced with a mixture of clay and gravel, just enough clay to bind the soil

without getting soupy when wet. Next to this soil cement was used. This binder, which may also be used to make emergency landing fields, is made by sprinkling cement on the surface, mixing it into the soil with a disk harrow, then packing and wetting. This is especially useful with sandy soil. In front of two revetments where airplanes were rolled in for service, the soft sand was held by a method developed by the British in Egypt. Here the sand was simply covered by strips of ordinary chicken wire, woven together and tied down by single strands of



Trailer Machine Shops Repair

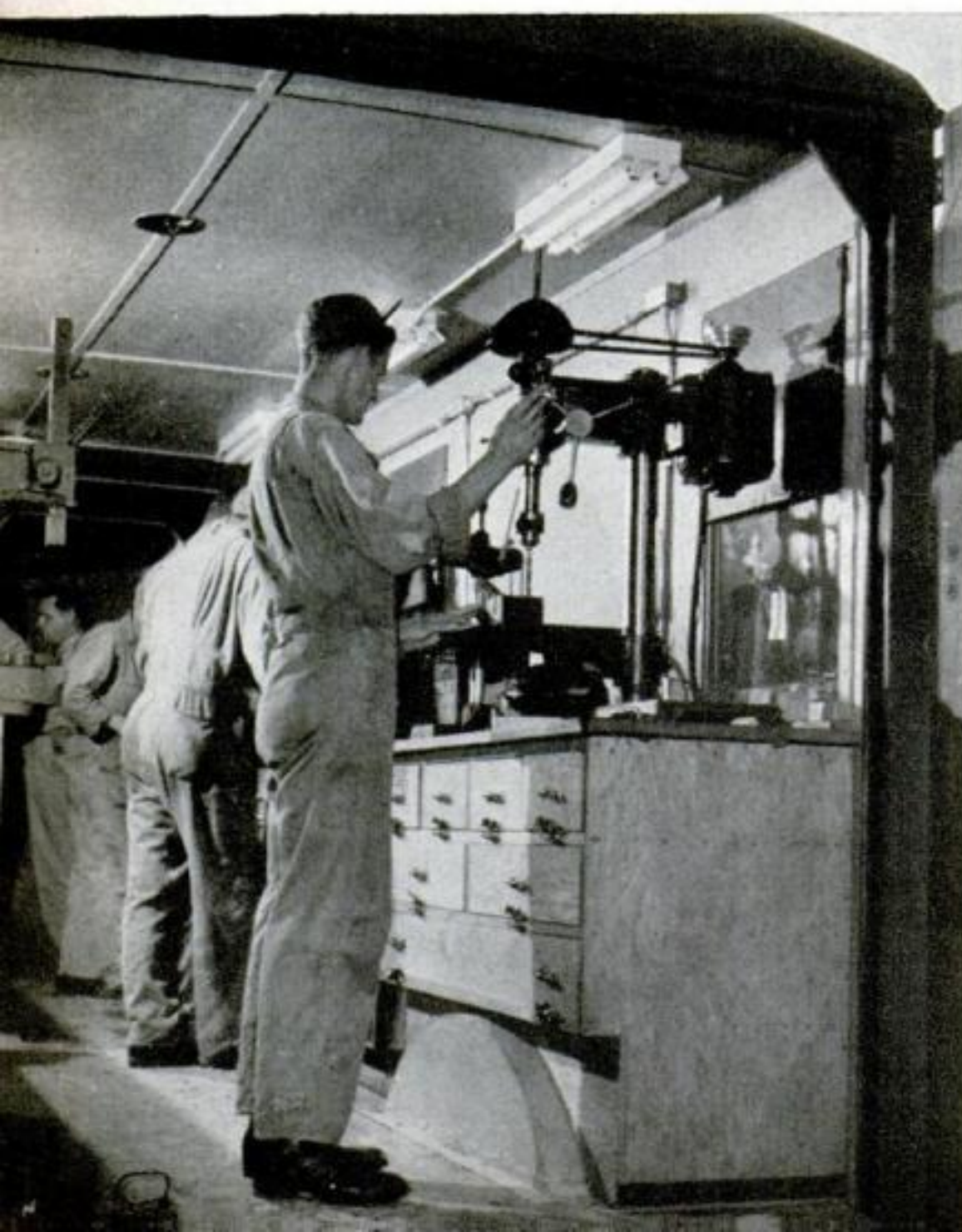
other wire. Most satisfactory method of all, because it darkened the ground and helped to hide the long white scars on the ground, was a sprinkling of calcium chloride, the chemical commonly put on roads to absorb moisture from the atmosphere and lay the dust.

Planes operating from such a field as this must be hidden, or they will become easy prey to enemy bombers. Along both sides

of Marston Strip the engineers constructed revetments—bays large enough to hold an airplane, protected on three sides by high walls of sandbags. These were concealed from air observers by “flats” of chicken wire strung over the top, festooned with strips of green canvas to resemble foliage.

In a big mound of earth left at one side of the strip was cut a revetment 100 feet across, big enough to hold a four-engine bomber. Pine trees were planted like telephone poles all over this promontory to resemble a natural grove. Into the bank near the revetment, the operations office of the field was constructed underground, built from pine slabs.

The encampment of the 126th Observation Squadron, operating from here, was hidden in natural woods across the field, along with more revetments. The steel strip itself was daubed with splotches of brown paint, in rows to resemble a peach orchard. In actual combat, however, it is practically impossible to conceal the general location



← Men at work inside the rolling machine shop that occupies one of the three trailers of a mobile pursuit-plane maintenance unit. Equipment includes air compressor, lathe, drill press

For operations that call for more elbow room, a tarpaulin → is stretched between two trailers to shelter a forge and sheet-metal workbenches. The men at right are shearing a piece of metal

of an active flying field, and the best defense is to mislead the enemy. In the fields around Marston Strip, dummy airplanes were built of canvas and tree branches, with canvas curtains around them to cast shadows like sandbag revetments. A water tank was rigged up with false wheels and cab to resemble a fuel truck. The idea is to give bombers something to shoot at, where they will do no harm.

Planes must have repair facilities as well as a place to land. To meet this need at advanced fields like Marston Strip, the Air Corps has developed a mobile repair unit consisting of three large trailers, one of which houses a complete machine shop while the two others carry supplies and spare parts. Such

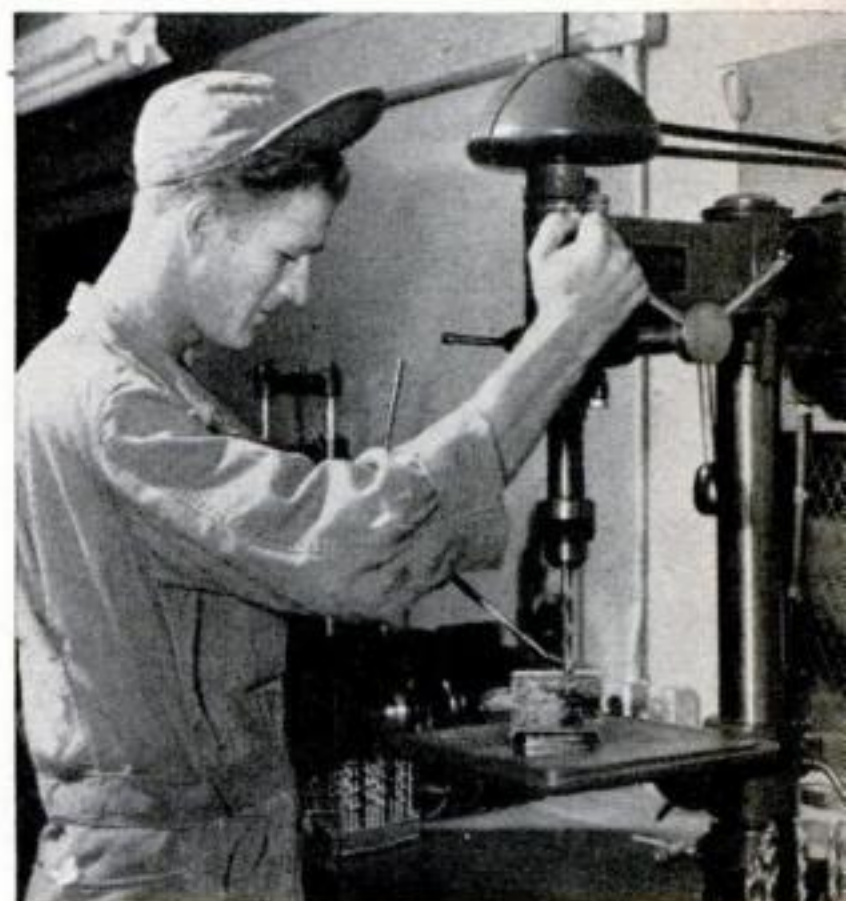
Planes at Advanced Fields

a unit can keep as many as 150 fighter planes in the air, saving precious time and fuel that would be required to fly them back to fixed bases.

Tanks and airplanes are of course the prime needs of the Army. But the means of using them effectively are equally important. In this respect the development at Marston Strip was one of the most encouraging things to appear in recent Army maneuvers. Certainly those revetments would have been useful in Hawaii and the Philippines.—HICKMAN POWELL.



Welding equipment also can be set up outdoors. A generator supplies current for operating power tools

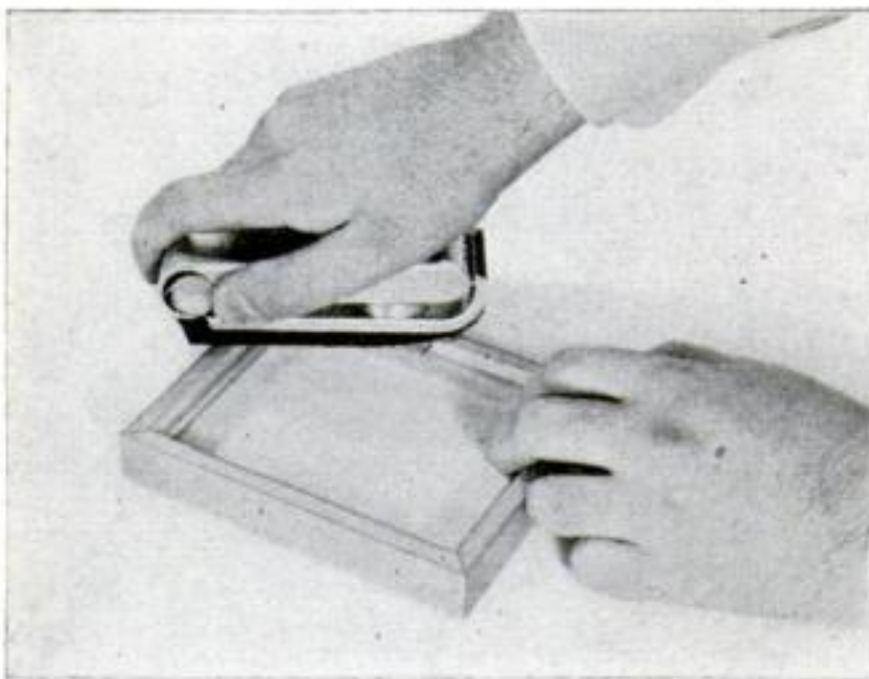
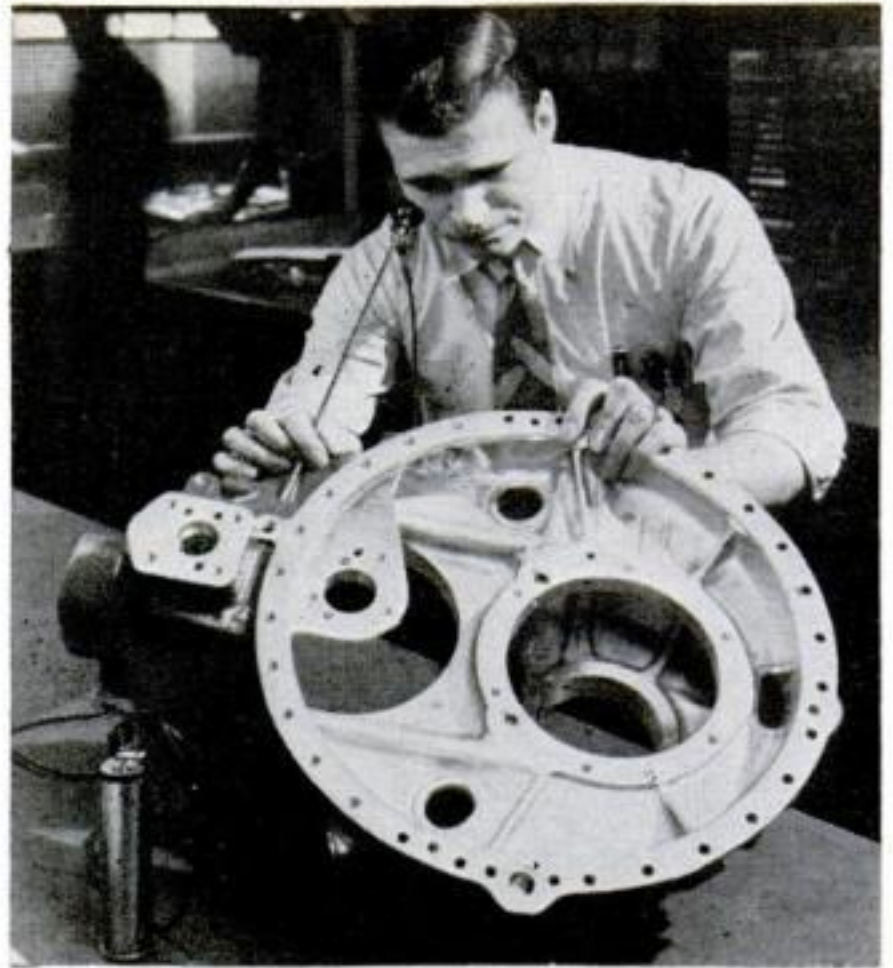


The shop-trailer drill press in use. Below is the battery-service stand that keeps vital electrical equipment functioning. Planes too badly damaged to be put back in action by the mobile unit can be repaired well enough to fly back to a fixed base



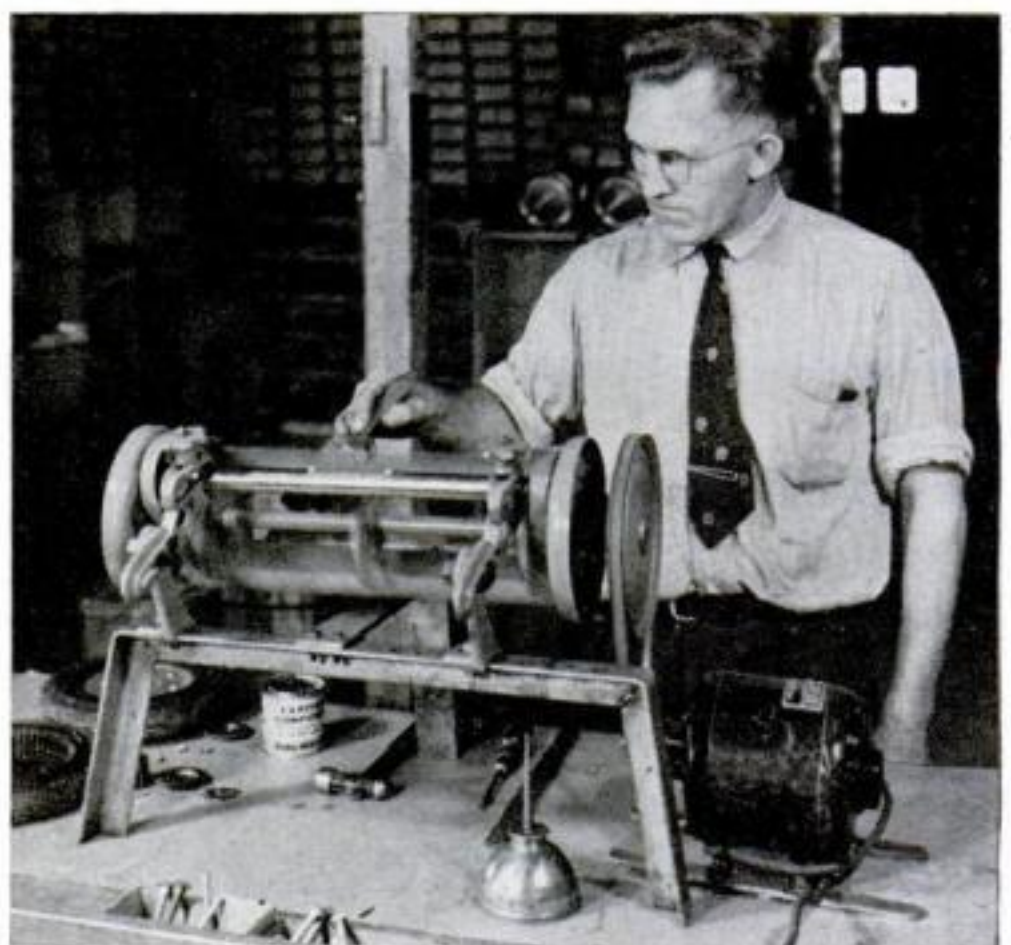
NEW Tools

CLOSE INSPECTION of machine parts is possible with a new optical instrument devised by an automobile company making aircraft-engine parts. Located at one end of a long, thin tube are a tiny light bulb a hundredth of an inch in diameter, and an equally small mirror. Looking into a microscopic sight at the other end of the tube, a mechanic can detect, by means of cross reflections on the angled mirror, any burrs or unevenness on machined surfaces.



A COMPACT SANDER, which has its abrasive surface cushioned on sponge rubber, is now available for solving many general household sanding problems. The one-half-inch, sponge-rubber cushioning gives an even pressure over the entire sanding surface and makes it possible to sand moldings or other small irregular areas. Instead of regular sandpaper, the tool uses a 20-inch roll of abrasive cloth which can be inserted in the machine and used as needed. Owing to the design and cushioning of the device, the user's hand and arm become less tired and the fingers are not exposed to the abrasive surface. It is constructed of cadmium-plated steel.

SHARPENING THE LAWN MOWER at home is greatly simplified by using a convenient stand that may be installed on the workbench. The mower, when clamped on this stand, is accessible for easy inspection of all the working parts. The wheels may be easily removed, and the blades are within easy working range of the operator. For sharpening purposes, a one-sixth-horsepower motor with a one-half-inch shaft, designed to turn counterclockwise at 1,750 revolutions a minute, is attached to the stand. The device enables the operator to put a keen edge on any lawn mower by lapping or backgrinding the blades with the aid of a special compound. The compound, composed of fine abrasive mixed with a semi-liquid grease, readily removes nicks on the reel blades and the bed knife.



Un-Natural History BY Gus Mager

THE DARNING NEEDLE, OR **DRAGONFLY**, CATCHES ITS PREY IN A BASKET FORMED BY ITS SIX LEGS AND THE FRONT OF ITS THORAX!

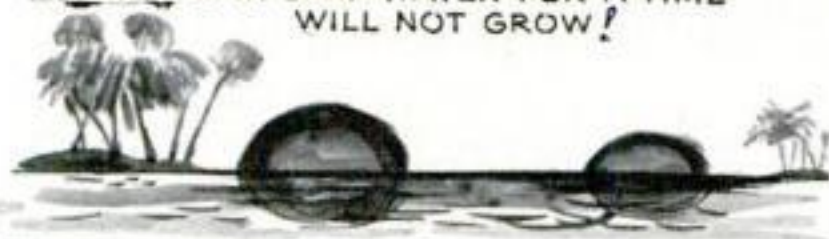


NO NOBLE BIRD IS THE **BALD EAGLE**! INSTEAD, HE IS A RACKETEER THAT LIVES OFF THE TIRELESS LABOR OF THE FISH HAWK, HIJACKING THAT ENERGETIC WORKER AND MAKING HIM DROP HIS PREY, WHICH THE FEATHERED GANGSTER CATCHES IN MID-AIR!

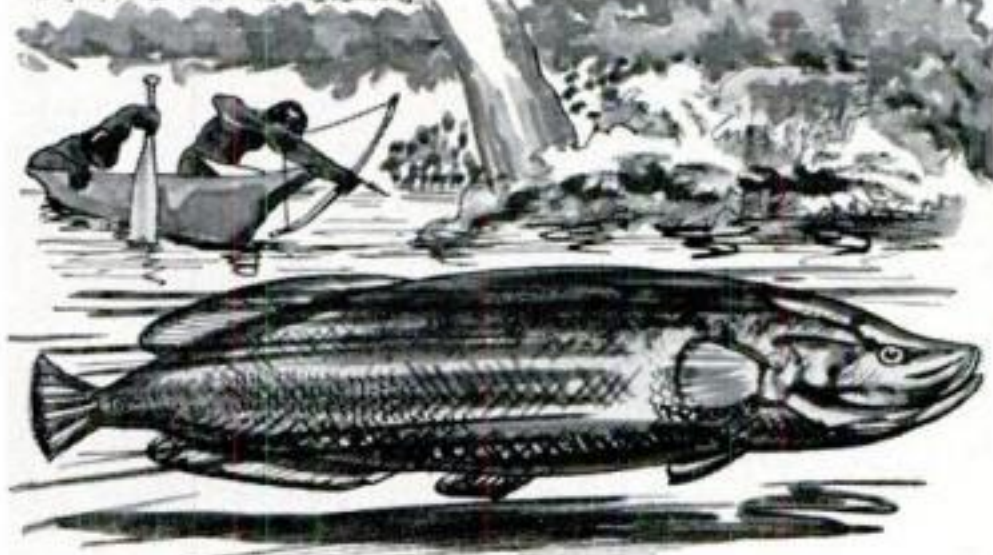


THE PROLONGED, ANGRY HISS OF THE AMERICAN **PINE SNAKE** OR **BULL SNAKE**, CAN BE HEARD 50 FEET AWAY. THIS ILL-NATURED REPTILE STRIKES VICIOUSLY AT THE SLIGHTEST PROVOCATION, BUT FORTUNATELY IS NOT POISONOUS!

SCIENTISTS USED TO THINK THAT THE **COCONUT PALM** WAS SPREAD BY OCEAN CURRENTS CARRYING ITS FRUIT FROM ONE LAND TO ANOTHER! HOWEVER, IT HAS NOW BEEN FOUND THAT A COCONUT THAT HAS BEEN IMMERSSED IN SALT WATER FOR A TIME WILL NOT GROW!



BIGGEST FRESH-WATER FISH IN THE WORLD IS THE ARAPAIMA, OF THE AMAZON AND OTHER SOUTH AMERICAN STREAMS! THIS SAVAGE MONSTER OFTEN ATTAINS A LENGTH OF 15 FEET AND A WEIGHT OF OVER 500 POUNDS!



SILVERY SNOW BUTTERFLIES, COMMON IN EUROPE, ARE FOUND FLYING ABOUT OVER PERPETUAL SNOW BANKS HIGH UP IN THE ALPS!

Playing Tricks with Plants

ESPALIER LIFTS ALL LIMITS ON LANDSCAPING DESIGNS

ESPALIER, the art of training plants to designs, centuries old in Europe, has made recent strides on the west coast of this country. Besides producing unusual shapes in ornamental shrubs, it is useful in cultivating vigorous fruit and nut trees in a landscaping scheme. The amateur can achieve almost any design. One specialist, W. H. Kemple, field superintendent for a nursery in Ontario, Calif., has developed 52.



Below, grafting a tree fence. Several trees are trained along wires in any of the horizontal-arm designs shown on the facing page, and the arms of the trees next to each other grafted together to form a single tree with a number of sets of roots. The arms are cut cleanly for grafting, tied, and sealed at the cuts with wax or grease



The simplest is the single upright. A newly planted fruit tree is cut back to 18 inches and the topmost bud trained up a tall stake. Every time the leader grows a foot, it is pinched out, forcing the side branches, which are cut halfway back to the trunk when they make a foot. This forms fruit spurs and eliminates energy-consuming wood.

A popular form is the double U, illustrated below. Standard stock is cut back to ten inches, and only the two topmost buds allowed to grow. Each is tied to a cross bar and trained horizontally. After they have attained a foot of growth, they are tied again and trained upward for another foot, where the process of de-budding and U-training is repeated.

In training a tree in the double U shown below, only the two topmost buds are allowed to grow on the trunk and two arms. The leaders are trained along wire as at the left. The photograph below is of a young tree after the first spring pruning





TRIPLE U



DOUBLE OBLIQUE CORDON



U IN U VERTICAL ARM CORDON



SINGLE HORIZONTAL ARM CORDON



FOUR VERTICAL ARM



FAN



DOUBLE U

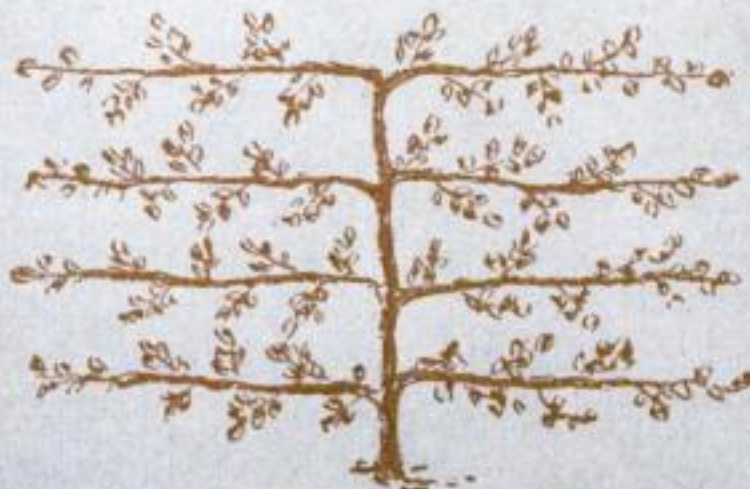


U OR DOUBLE UPRIGHT CORDON



SINGLE SPIRAL CORDON

SINGLE SERPENTINE



HORIZONTAL ARM



THREE VERTICAL ARM



ROMAN-WARD



DOUBLE ARM HORIZONTAL CORDON

HORIZONTAL SPIRAL

Here's My Story



1 BORN ON A FARM IN DELPHOS, OHIO, LESLIE C. PELTIER FOUND A NEW INTEREST OUTSIDE OF THE REGULAR FARM ROUTINE WHEN HE WAS PRESENTED WITH A BOOK ON STARS FOR CHRISTMAS



2 HE BECAME SO INTERESTED IN STARGAZING THAT, AT THE AGE OF SIXTEEN, HE PICKED 900 QUARTS OF STRAWBERRIES, AT TWO CENTS A QUART, TO PURCHASE A TWO-INCH TELESCOPE



3 WHEN HE HAD COMPLETED THREE YEARS OF HIGH SCHOOL, HIS BROTHER JOINED THE ARMY. THIS KEPT LESLIE AT HOME TO HELP WITH THE FARM WORK. WHEN NIGHT CAME, HE WOULD GO TO HIS TELESCOPE AND CHART THE STARS, ESPECIALLY THE VARIABLE ONES



4 NEVER OVERENTHUSIASTIC ABOUT FARMING, HE WORKED AS AN AUTO MECHANIC, AS A SALESMAN, AND LATER AS A DRAFTSMAN IN A TOY FACTORY



5 AFTER WORK AT HIS OFFICE IN DELPHOS, PELTIER WOULD GO BACK TO THE FARM AND WORK ON ASTRONOMICAL CHARTS WHICH HE SENT REGULARLY TO THE HARVARD UNIVERSITY OBSERVATORY

THE CAREER OF LESLIE C. PELTIER



INTERESTED IN HIS CAREFUL REPORTS, HARVARD LENT HIM A FOUR-INCH TELESCOPE. LATER, PRINCETON LET HIM USE A SIX-INCH INSTRUMENT



WITH HIS FATHER'S HELP HE BUILT A TINY OBSERVATORY ON AN UPLAND MEADOW OF THEIR FARM. ALTHOUGH IT COST ONLY \$100 TO BUILD, IT HAS BECOME WORLD-FAMOUS FOR DISCOVERIES MADE THERE

8 B.W. SCHLATTER

AT 9:30 P.M. ON MAY 14, 1936, PELTIER FOUND WHAT HE THOUGHT WAS A NEW COMET ALMOST AS BRIGHT AS HALLEY'S. SURE OF HIS FIND BY 2:30 NEXT MORNING, HE DASHED TO A PHONE AND CALLED DR. HARLOW SHAPLEY AT THE HARVARD OBSERVATORY

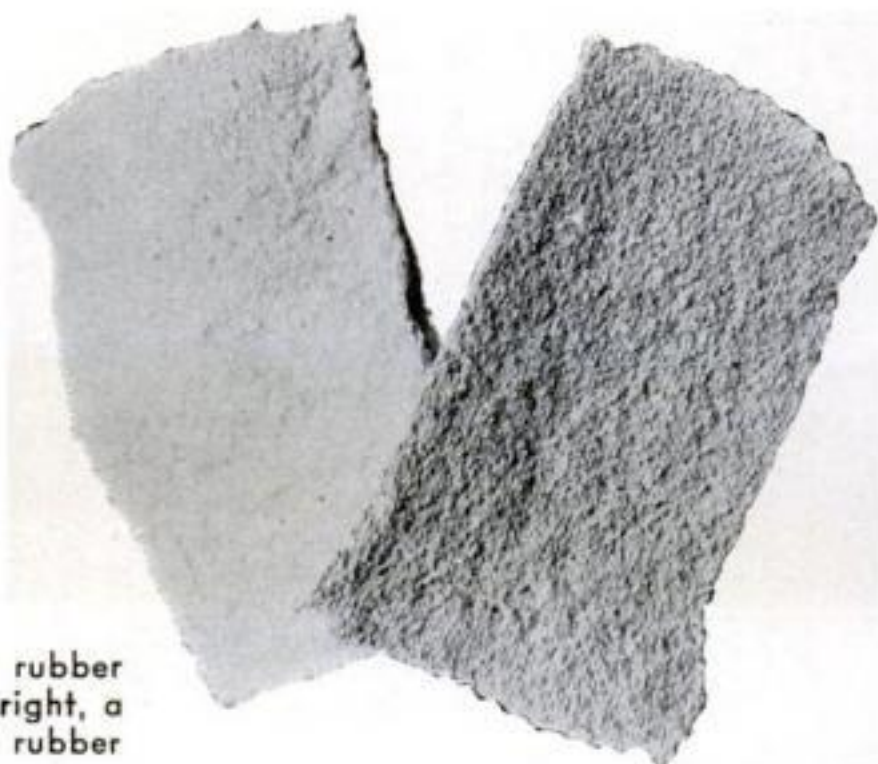


DR. SHAPLEY, JUST TURNING IN FOR A NAP, HEARD AN ASSISTANT CALL FROM THE PHONE, "PELTIER HAS DISCOVERED A NEW COMET!" STILL AN AMATEUR, HE HAS DISCOVERED OR CODISCOVERED SEVEN COMETS AND A STAR, AND CONTINUES TO DO HIS STARGAZING AFTER WORK IN THE TOY FACTORY



Synthetic Rubber

MADE FROM PETROLEUM,
GAS, AND AIR



An automobile tire made of "Hycar," a synthetic rubber developed by the B. F. Goodrich Company. At the right, a sheet of raw synthetic (left) contrasted with natural rubber

VIRTUALLY all the country's rubber, in the past, has been imported from the Far East. But war with Japan now threatens to cut off the supply. Stock piles of rubber, built up here in preparation for the emergency, will not last indefinitely. For auto tires and tubes, rubber heels, and industrial products such as electrical insulation, Americans will have to turn to synthetic rubber, now in mass production by leading firms.

From petroleum, gas, and air comes an all-American rubber known as "Hycar"—short for hydrocarbon—manufactured by a jointly owned subsidiary of the B. F. Goodrich Company and the Phillips Petroleum Company. Six tons of the product are turned out daily at Akron, Ohio.

"Cracking" petroleum to recover gasoline yields a by-product, butadiene, one of the chief ingredients. Above 23 degrees F., butadiene normally is a gas, but tank cars deliver it to the plant's storage tanks as a liquid, under a pressure of 20 to 40 pounds to the square inch.

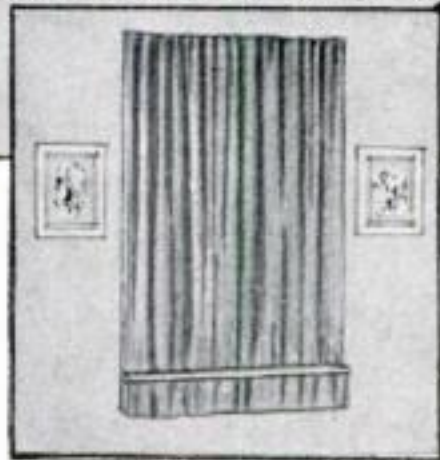
Chunks of the synthetic, cut from a big block, go onto a wash mill where moisture is extracted and the material is formed into thin sheets. It is processed like regular rubber

Agitated with soap solution in large steel pressure vessels, the butadiene and other ingredients undergo a curious phenomenon named polymerization, in which small molecules clump together to form big ones. The result is a thick milky-white liquid resembling the latex that drips from rubber trees. Further treatment imparts resistance to heat and oxygen and coagulates it into a solid curd. Standard rubber machinery washes the material and forms it into sheets and other commercial shapes. Tires made from the synthetic rubber look exactly like those of natural rubber, which they equal or excel in performance. This takes on particular importance because three fourths of the rubber consumed in the United States is estimated to go into tires and inner tubes.

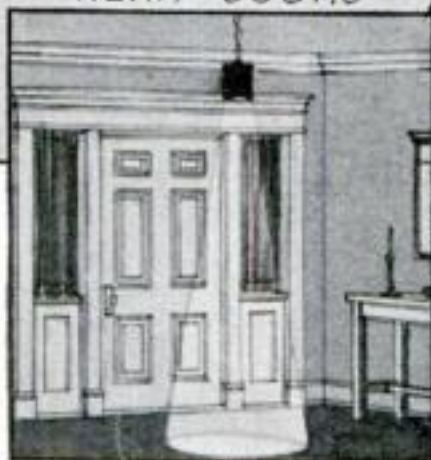




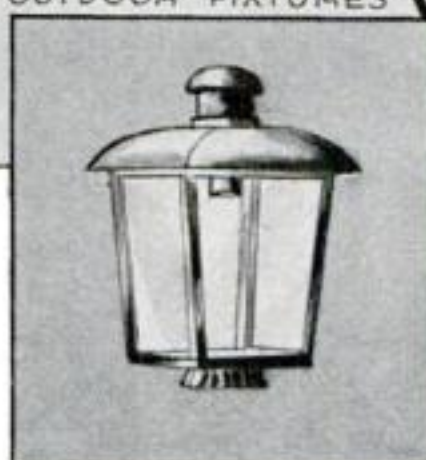
BLACKOUT WINDOWS OF ALL OCCUPIED ROOMS



SCREEN LIGHTS NEAR DOORS



REMOVE BULBS FROM OUTDOOR FIXTURES



PAINT STEPS WITH LUMINOUS PAINT



BLACKOUT—

Here are some of the important points to look out for in getting your house ready for a possible blackout order

HOW TO PREPARE YOUR HOME OR YOUR FACTORY

By HENRY H. SAYLOR

BLACKOUT is not a precaution that you or I take merely in the hope of averting personal harm. As a matter of cold fact, this nation at war cannot take the time to concern itself seriously about whether you or I as individuals are blotted out. What it does concern itself about is the safety of people in the mass.

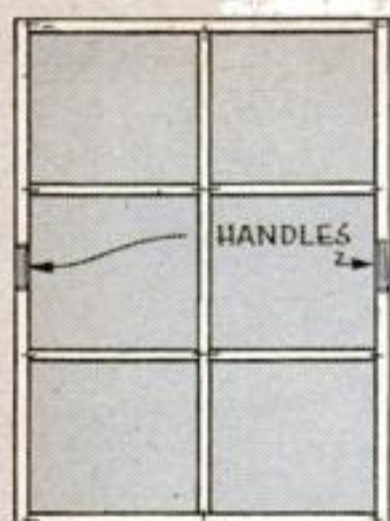
Blackout protection is not something that you or I can take or leave alone. You may have thought you would not bother with it, preferring to take your chances. But it is not a personal matter; it is not your individual safety with which you would be taking chances, but the safety of your whole community and the life-or-death war effort of your country.

It is unlikely that the vast area of the

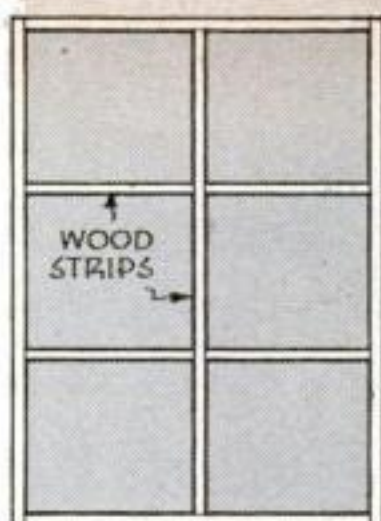
United States will ever have to be blacked out. Strategic sections will undoubtedly have to be prepared for instant protection of this kind. Civilian Defense units, working hand in hand with the military, will tell us what to do and when to do it. This article, based on the booklet "Blackout" issued by the U. S. Office of Civilian Defense, is in no sense a plea to start hanging up black curtains. Do not rush out and stock up with materials for which you may not, after all, have any need, thereby causing shortages in locations that may have earlier need of them. Wait for the word from your local Civilian Defense authorities.

Two great reasons are behind the blackout defense. The more obvious is protection; the other, even more important, is production.

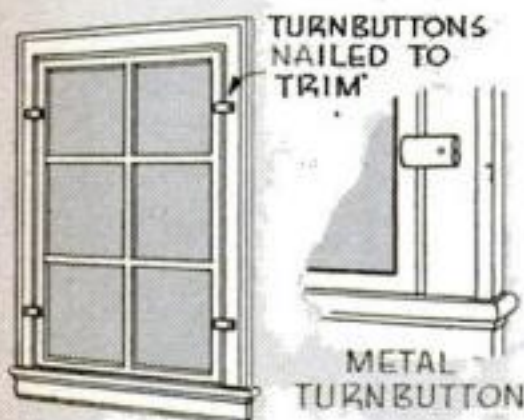
In the early days of the war abroad, the



INSIDE VIEW



OUTSIDE VIEW



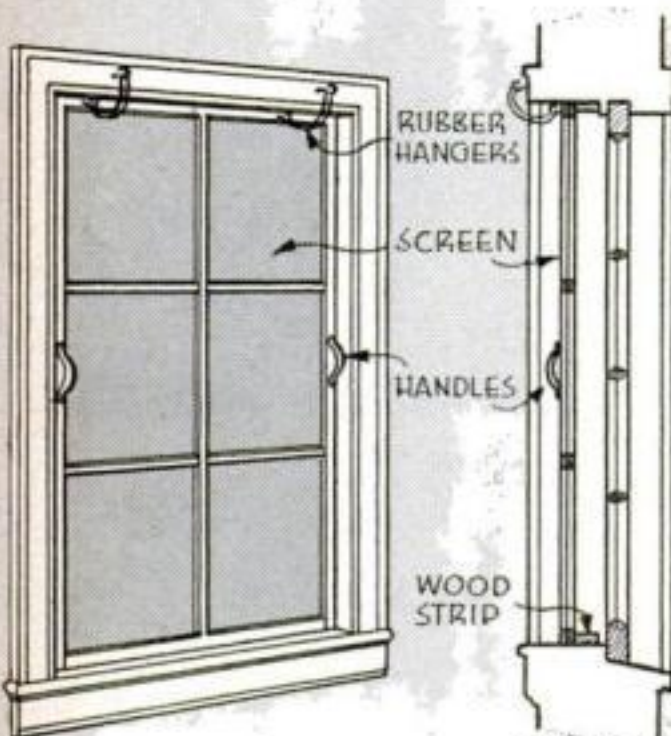
TURNBUTTONS
NAILED TO
TRIM

METAL
TURNBUTTON



HEAVY
RUBBER
BAND

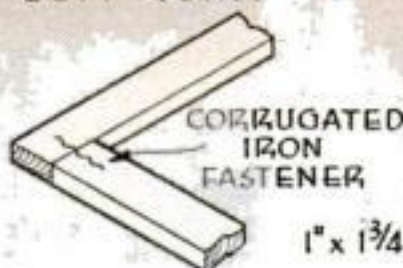
SUSPENSION
HOOK



INTERNAL LIGHTWEIGHT
OPAQUE SCREEN

SECTION

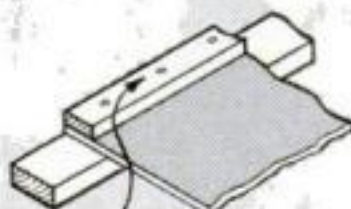
BUTT JOINT



HALF-LAP JOINT



METHODS OF FIXING SHEET MATERIAL TO FRAME



STRIPS NAILED THROUGH
SHEET MATERIAL TO FRAME

SHEET MATERIAL TURNED UP
OVER EDGE OF FRAME AND NAILED



EDGE FIXING AND
GASPROOFING



RUBBER OR FELT
TACKED TO EDGE OF FRAME

CORRUGATED
BOARD SCREENS



EDGE OF BOARD
FOLDED AND TURNED

Windows can be fitted with lightweight screens or light traps

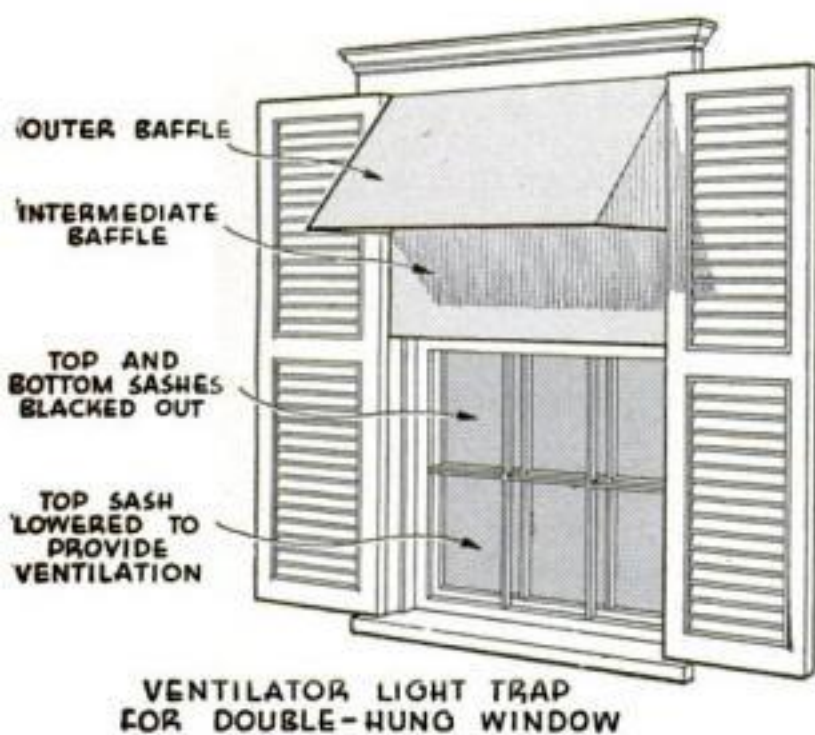
banshee wail of the sirens drove most people from their occupations; workers left their benches for deep shelters; production stopped. With every alarm Britain lost many man-hours of work on planes, guns, munitions, tanks. That lesson was soon learned, and blackout, with the aid of camouflage, helps to keep production moving.

Nor is it manufacturing only that must be preserved from interruption. The whole flow of our national life—the work of housekeeper, home craftsman, student, researcher, telephone operator, doctor—will be maintained most effectively by intelligent use of blackout.

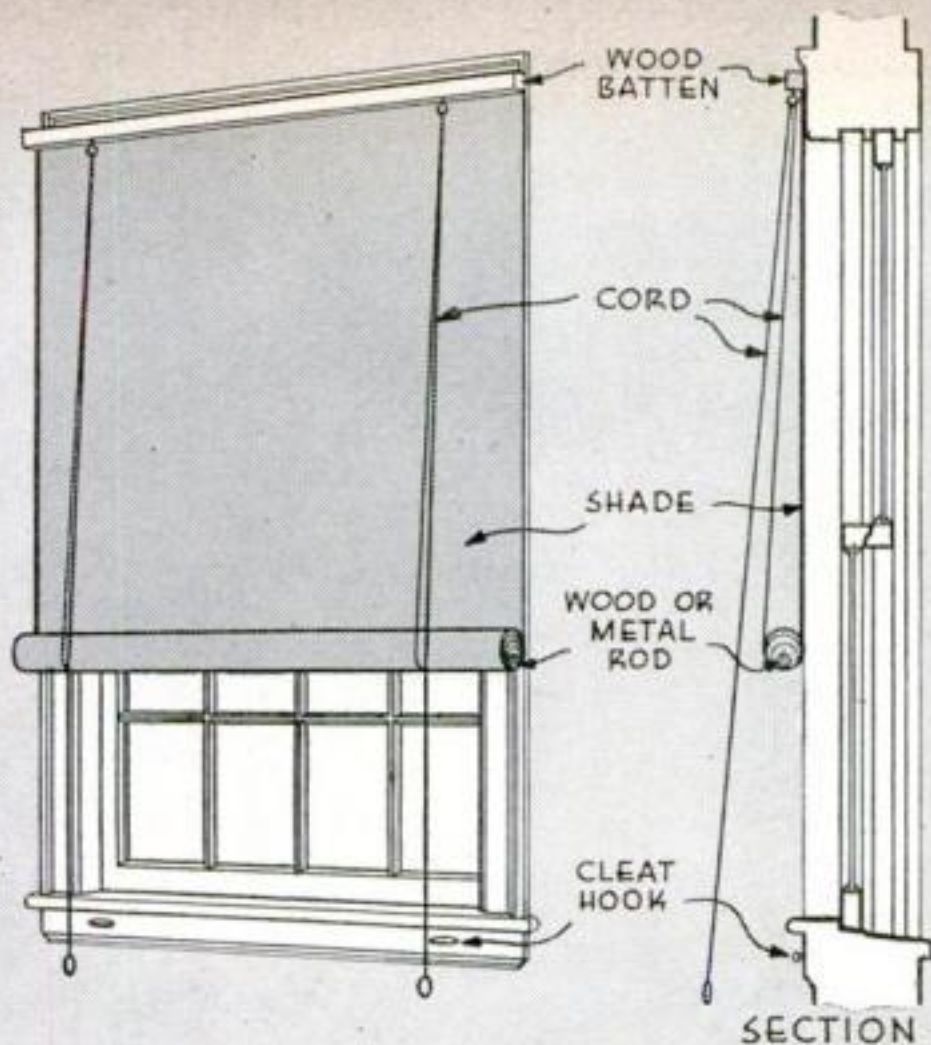
Blackout is not a cure-all. On clear nights, even without moonlight, the location of a city cannot be hidden. Rivers, lakes, reservoirs have reflecting surfaces that, with his maps, tell the airman a clear story. Flares that he drops are further aids. Nevertheless, blackout hides the pattern of streets, which would guide attacks on specific objectives. And in order that the heart of the city not be revealed by contrast with the scattered lights of residential sections, these too must be hidden.

What will concern most of us is the job of blacking out our own dwellings. In most cases we can confine our activities during a blackout period to a few rooms—perhaps to the kitchen alone. But outdoor lights, too easily forgotten or turned on by mistaking a switch, had better be robbed of their bulbs.

Windows, in the rooms we shall need, are easily obscured by tacking opaque fabric to a pair of sticks, window-frame height, and wedging these between sill and top behind the vertical edges of the sash. The fabric should be of proper width to stretch tautly across the opening, and, when not in use, rolls up on the pair of sticks and is conveniently stored near-by. It also affords some protection against flying glass from an outside blast. Other devices for window



VENTILATOR LIGHT TRAP
FOR DOUBLE-HUNG WINDOW



Temporary screen blind and, right, another inexpensive screen that can be made easily by the handy man

What To Do During a Blackout

IF YOU ARE INDOORS



Turn off the gas supply at the meter if you know how to do it properly. (Be sure to relight all pilot lights on such appliances as stove, refrigerator, water heater, when gas is turned on again)



When the alarm is sounded, lay in a supply of water in bathtub or basins. You may need it for drinking, sanitary arrangements, or fire fighting if the regular supply fails during the alarm



Turn out lights all over the house except in one or two rooms prepared for blackout use. Remove the bulbs from exposed lights, especially those outdoors; they might be turned on by some mistake



Don't use the telephone. To get news and instructions, keep a radio tuned in on a reliable station. Don't believe any unofficial reports

IF YOU ARE OUTDOORS

Screen your flashlight with several thicknesses of paper cupped around the end, thus dimming the beam. Use it as little as possible, and never point it upward or at any light-reflecting surface



If you are driving when a raid alarm is sounded, park your car as quickly as possible, lock it, and go to the nearest building or shelter. Leave the center of street clear for emergency traffic

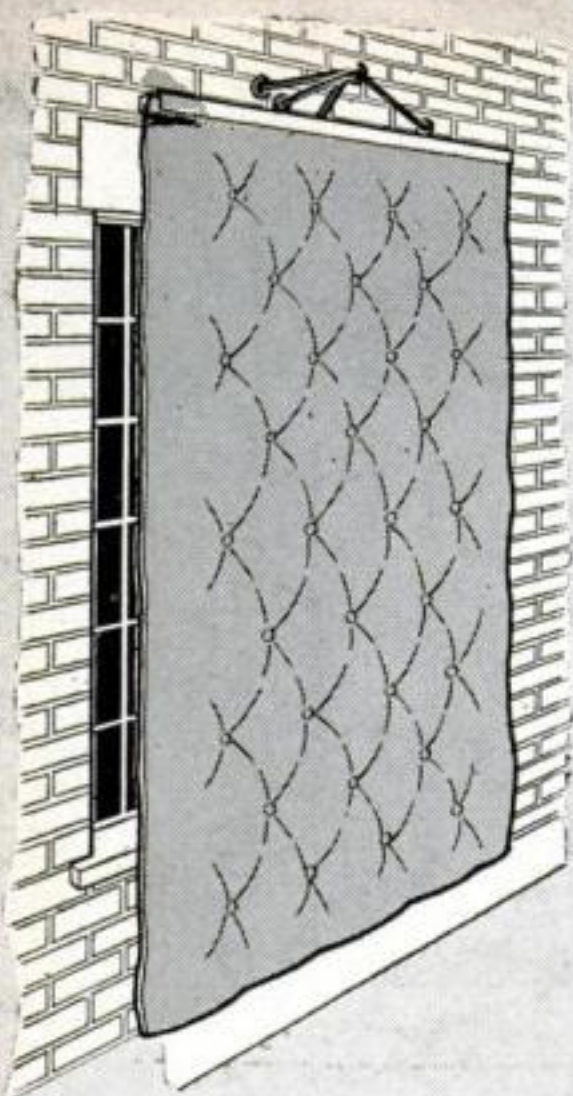


When taking a pet out after dark, with a blackout possible, keep it on a leash. Otherwise it may become separated from you in an alarm and run away, endangering others by getting in the way

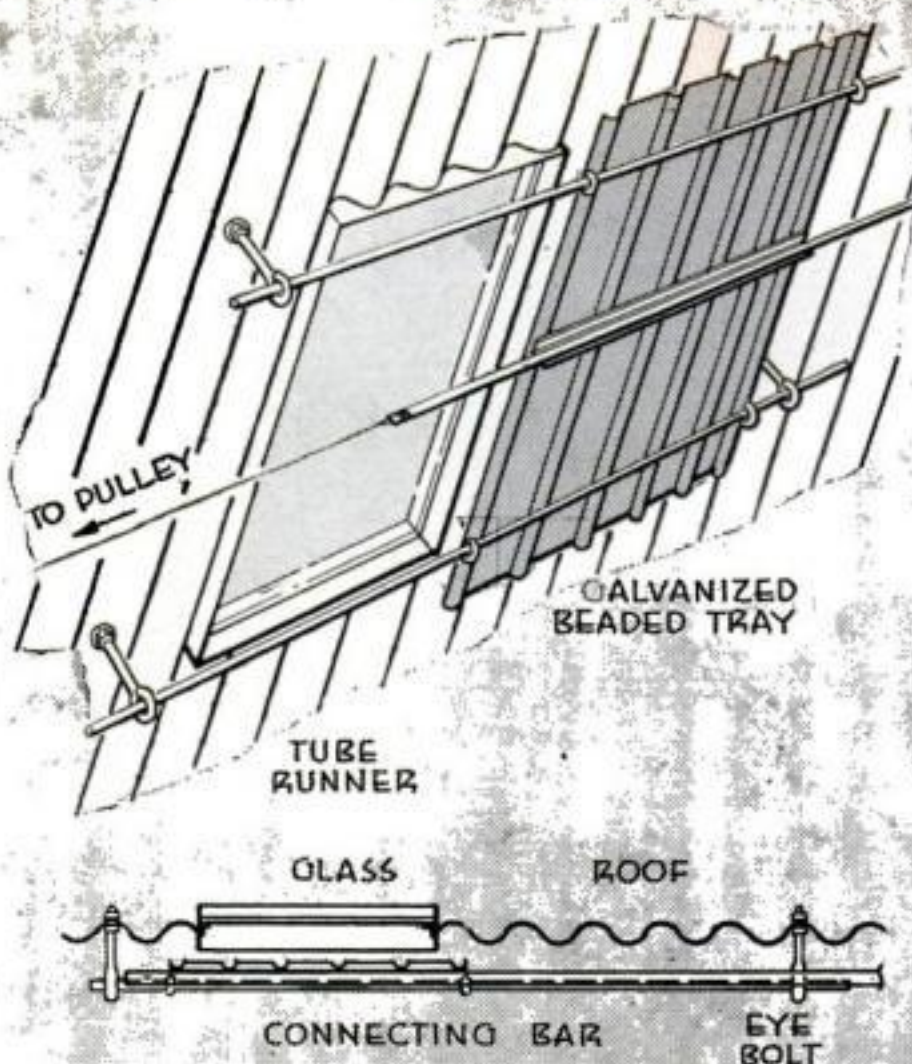


If bombs start falling before you can reach shelter, lie down on your back and cover your face with an arm to protect most vital areas





BLAST MATTRESS



SLIDING TRAY SCREEN UNDER ROOF LIGHTS

Factory windows present special problems. Here are a blast mattress for shielding a large window, and a sliding tray screen for a roof light. Wherever practicable, roof lights should be painted black

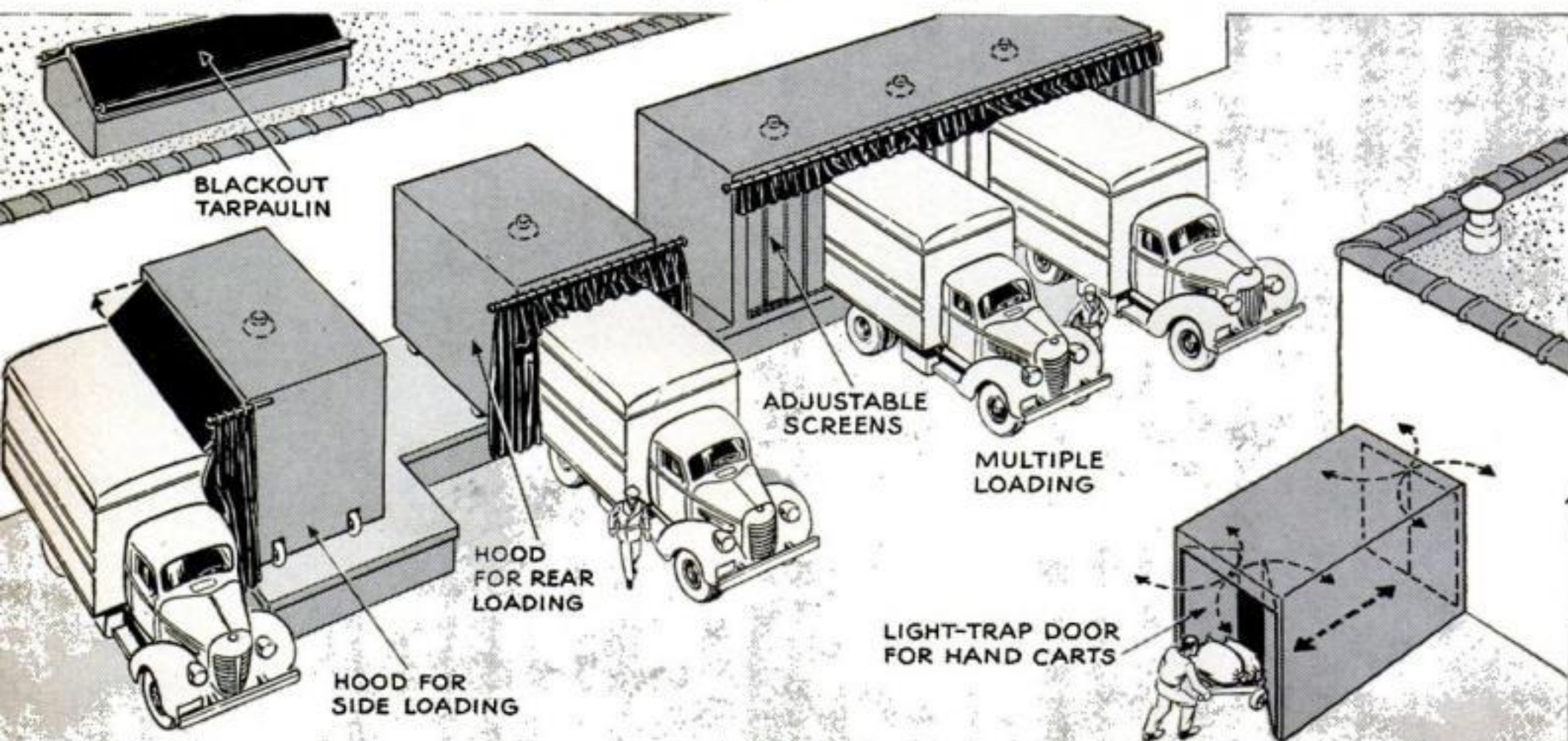
protection are suggested in accompanying drawings. The danger of window breakage from blast, incidentally, may be halved by dropping the upper sash behind the lower one. Leave casement windows open.

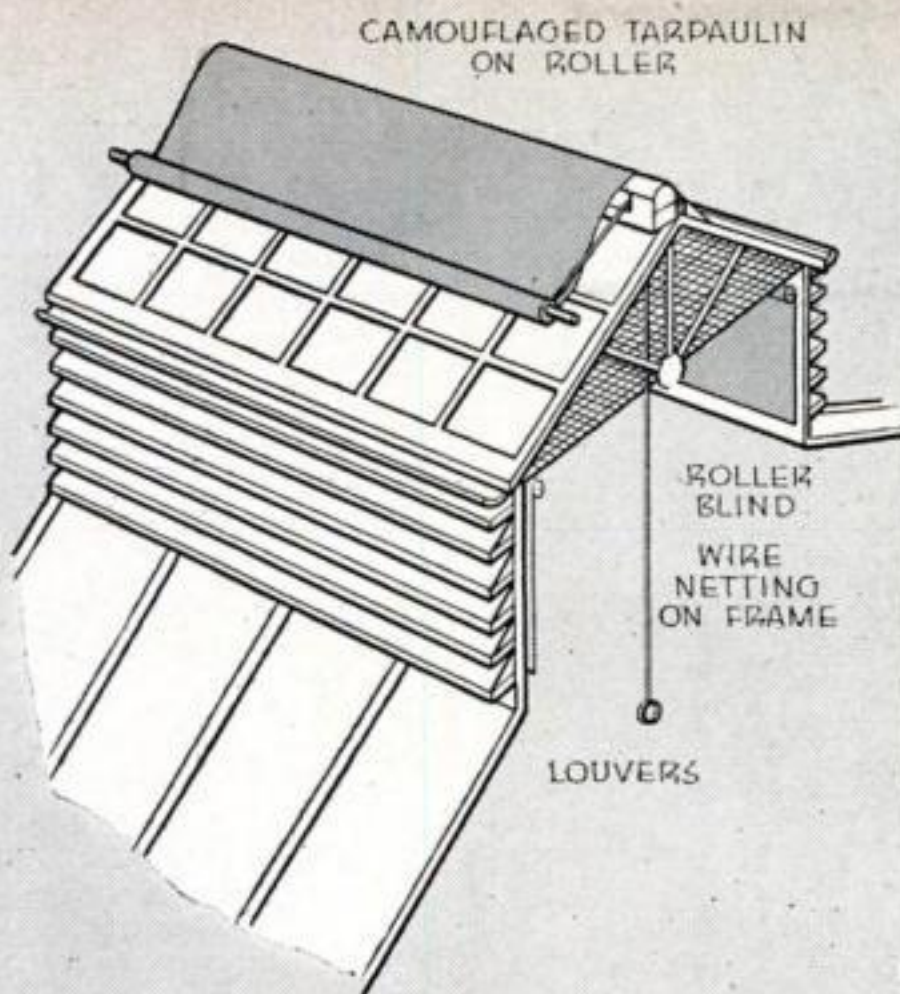
The general public is advised, on good authority, not to try blackening any windows in the home with paint. Heavy drapes, cardboard frames, or any other makeshift devices are equally good and may be removed in the daytime.

For skylights, and factory windows which it is impossible to cover with the above-mentioned devices, a paint may be prepared in the following manner: Reduce ordinary lampblack (ground in oil) with a mixture of 1 part good varnish, 7 parts (by volume) of pure turpentine. To facilitate removal, add a small amount of paraffin oil.

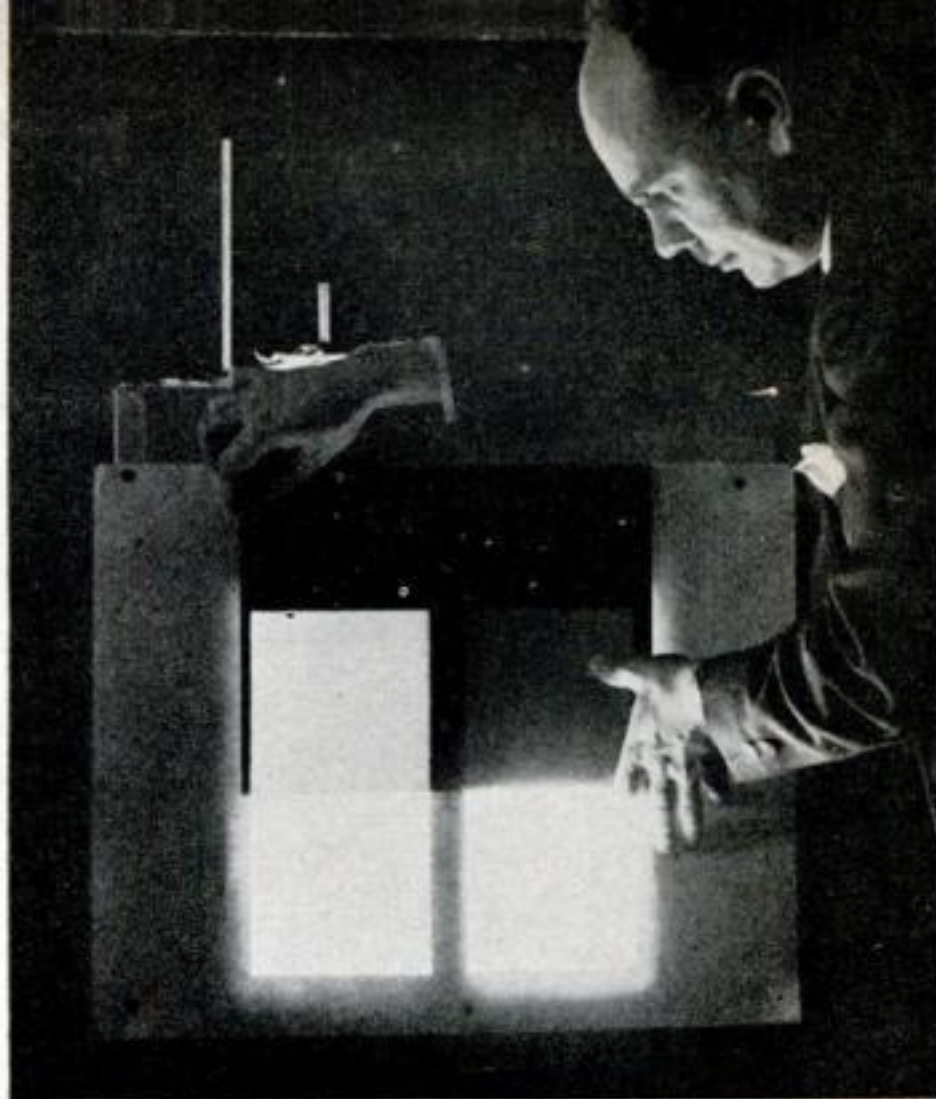
Large panes of glass should have shock-absorbing materials applied. Adhesive strips of tough paper or fabric may be put on in a

Loading platforms can be made practically light-tight. The drawings show three different arrangements





LIGHTPROOFING FACTORY SKYLIGHT



Blue glass, used with yellow sodium-vapor interior lighting, "blacks out" busy factories. In this test, incandescent light in left panel passes through glass, yellow light does not

Cupola skylights can be treated as illustrated above. Sawtooth and monitor roofs also require special care

close pattern. The adhesive should remain slightly tacky. Ordinary flour paste to which is added five percent of glycerine or molasses, will serve. Tire tape or surgical adhesive tape make good reinforcement, spaced not over 6 inches apart each way.

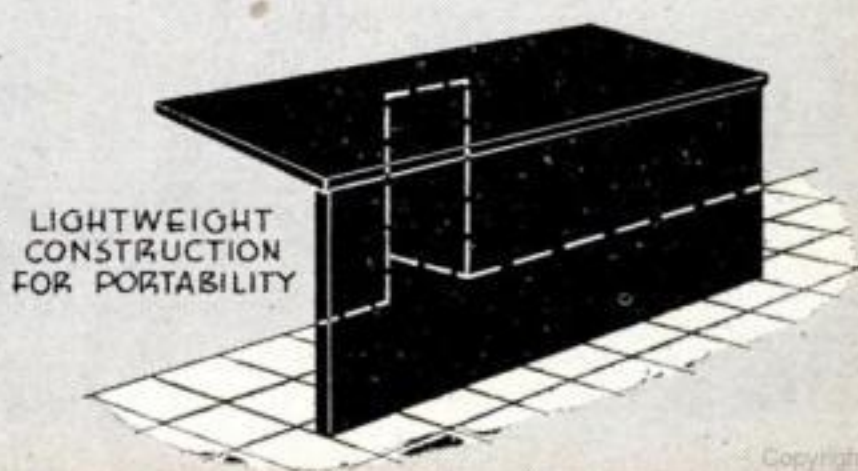
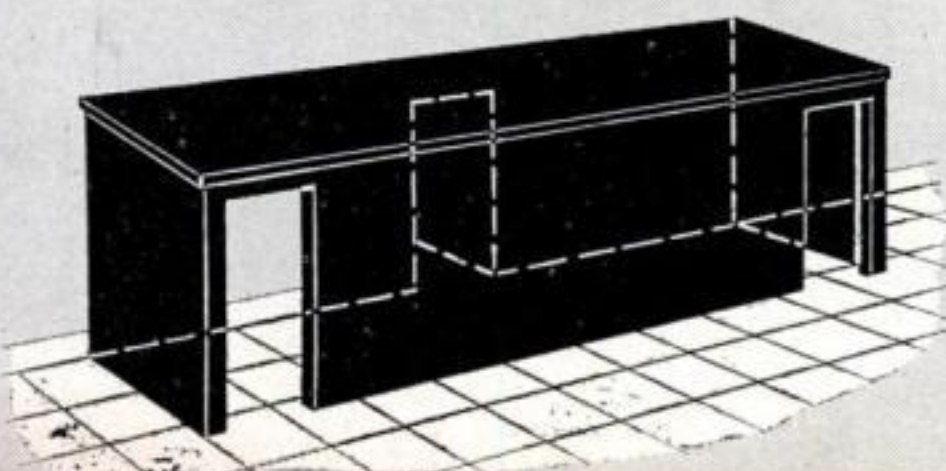
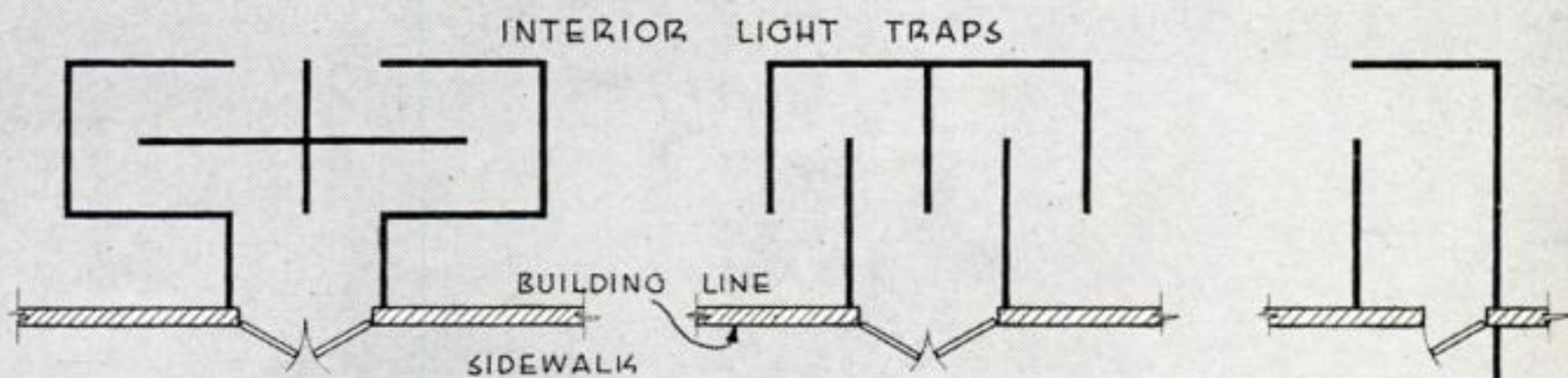
Destructive splintering of glass is sometimes avoided by wire netting of not over $\frac{1}{2}$ -inch openings, placed close to the glass.

The factory brings additional difficulties in that skylights, saw-tooth and monitor

roofs cannot, in most cases, be permanently obscured. Loading platforms, truck garages, the need for frequent opening of outside doorways—all these and similar danger points need special treatment.

Once more, then, await the instructions of your Civil Defense unit. You may never need blackout precautions, but if and when your house or factory requires this protection, you will know the "why" and at least some of the "how."

Light traps shield street entrances. Those used outside may be of lightweight, portable construction



LIGHTWEIGHT CONSTRUCTION FOR PORTABILITY

EXTERIOR LIGHT TRAPS FOR STREET ENTRANCES



Making the tuberculin patch test for tuberculosis. The specially treated adhesive patch is placed on the skin and left there for 48 hours. If tuberculosis germs are present in the system, a positive reaction will appear after another 48 hours in the form of a square reddened spot, seen below

Simple Test for Tuberculosis Can Be Given in Schools

TUBERCULOSIS may be recognized in early stages by a simple test that is easily made by schools and health groups. Painless, speedy, this "tuberculin patch test" consists of placing a specially treated adhesive bandage on a person's skin. Forty-eight hours later it is removed, and, after another 48 hours the reaction is seen. If a reddened square spot appears where the patch touched the skin, the reaction is positive.



Gasoline-Powered Wheelbarrow Saves Labor and Liniment

PUSHING a wheelbarrow load of cement up a runway can be hard on the arms and shoulders—unless you are using a motorized barrow invented by Albert DeLucchi, 29-year-old San Francisco contractor. The power is provided by a one-horsepower gaso-

line engine mounted between the handles and connected to the balloon-tired wheel by means of a chain. A quart of fuel, fed by gravity from a tank set on the back of the bucket, is said to be sufficient to operate the barrow for a whole day's work.



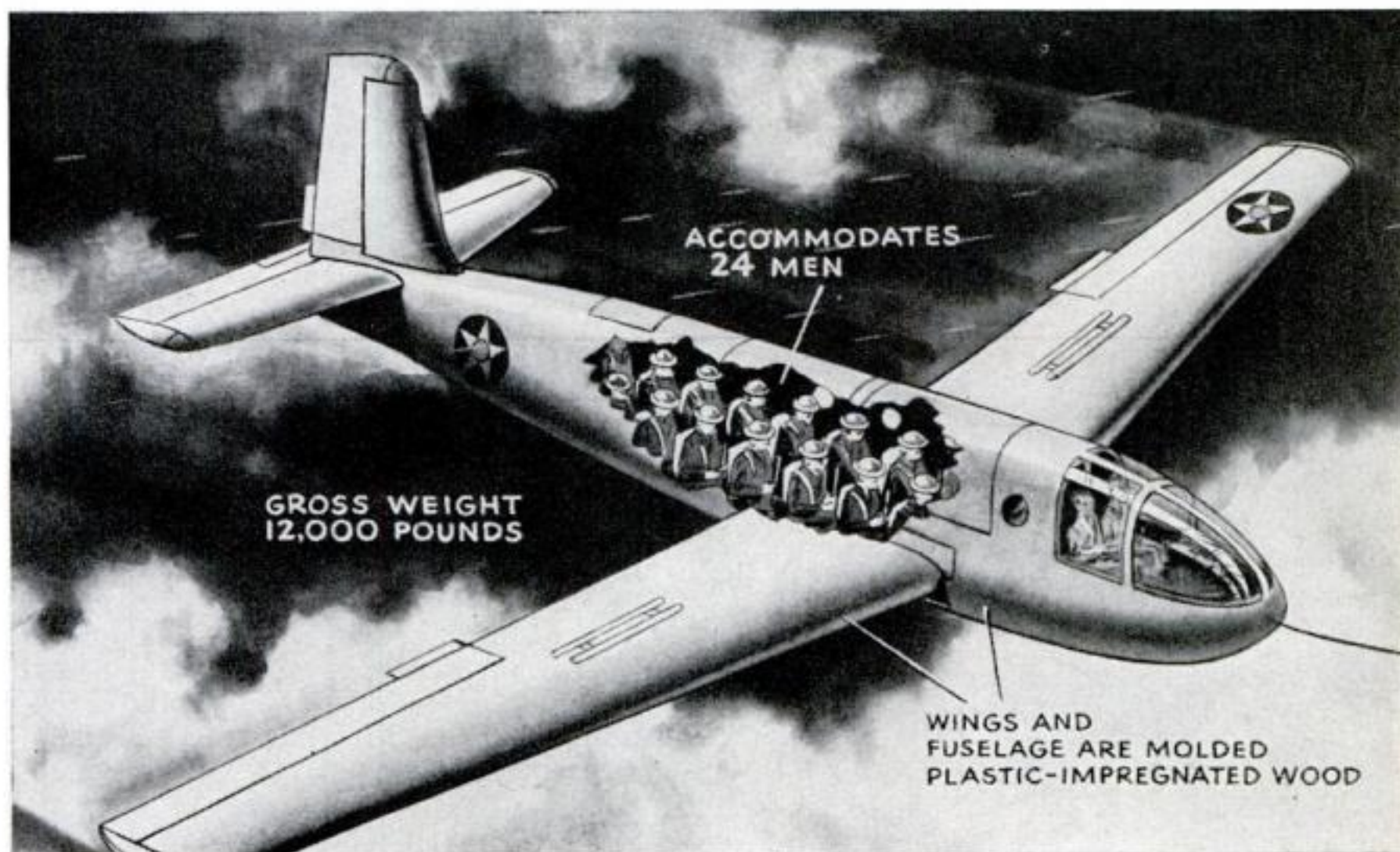
Albert DeLucchi demonstrates the use of his motorized wheelbarrow. All the worker has to do is lift



This one-horsepower engine does the pushing. It is controlled by a lever mounted on the right handle

Big Navy Transport Gliders

ARE MOLDED FROM WOOD PLASTIC



Largest of three types of wood-plastic gliders being built for the Navy, this one will transport 24 men

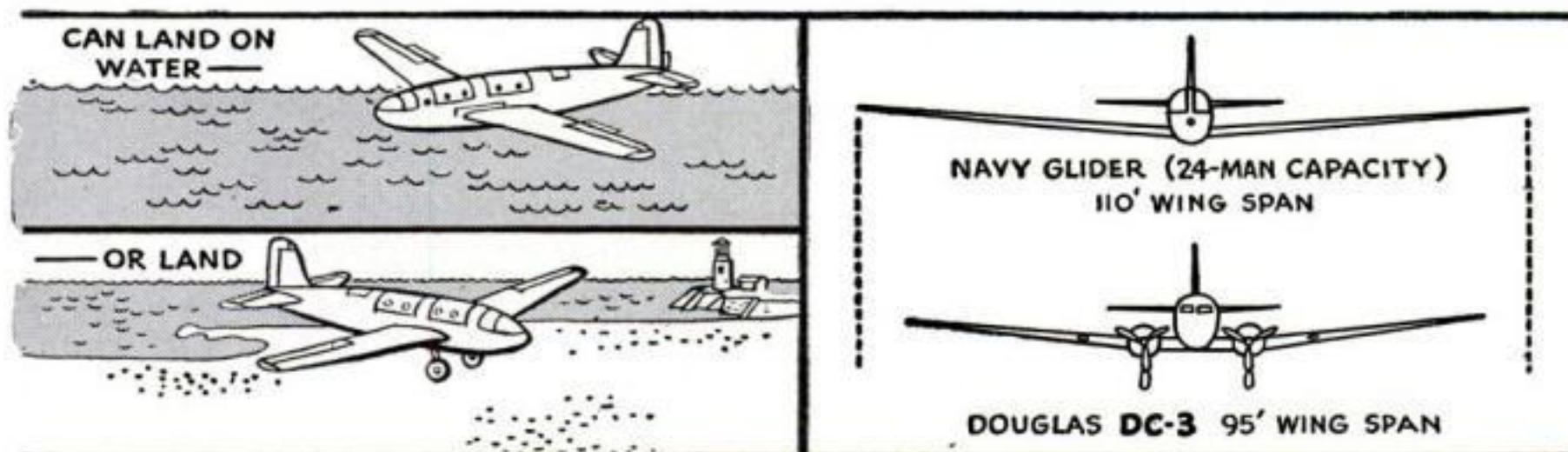
VISUALIZING the possible use of non-strategic material in plane construction, the Navy has ordered 14 gliders built of plywood impregnated with resin. Two of these, carrying 24 men each, will have a wing span of approximately 110 feet and a gross weight of 12,000 pounds. Two 12-place gliders, weighing about 6,500 pounds, will have a wing span of 70 feet. The remaining ten are smaller, two-place jobs for training.

The hot-pressed resin-bonded plywood specified has undergone extensive tests and been found particularly suited for gliders.

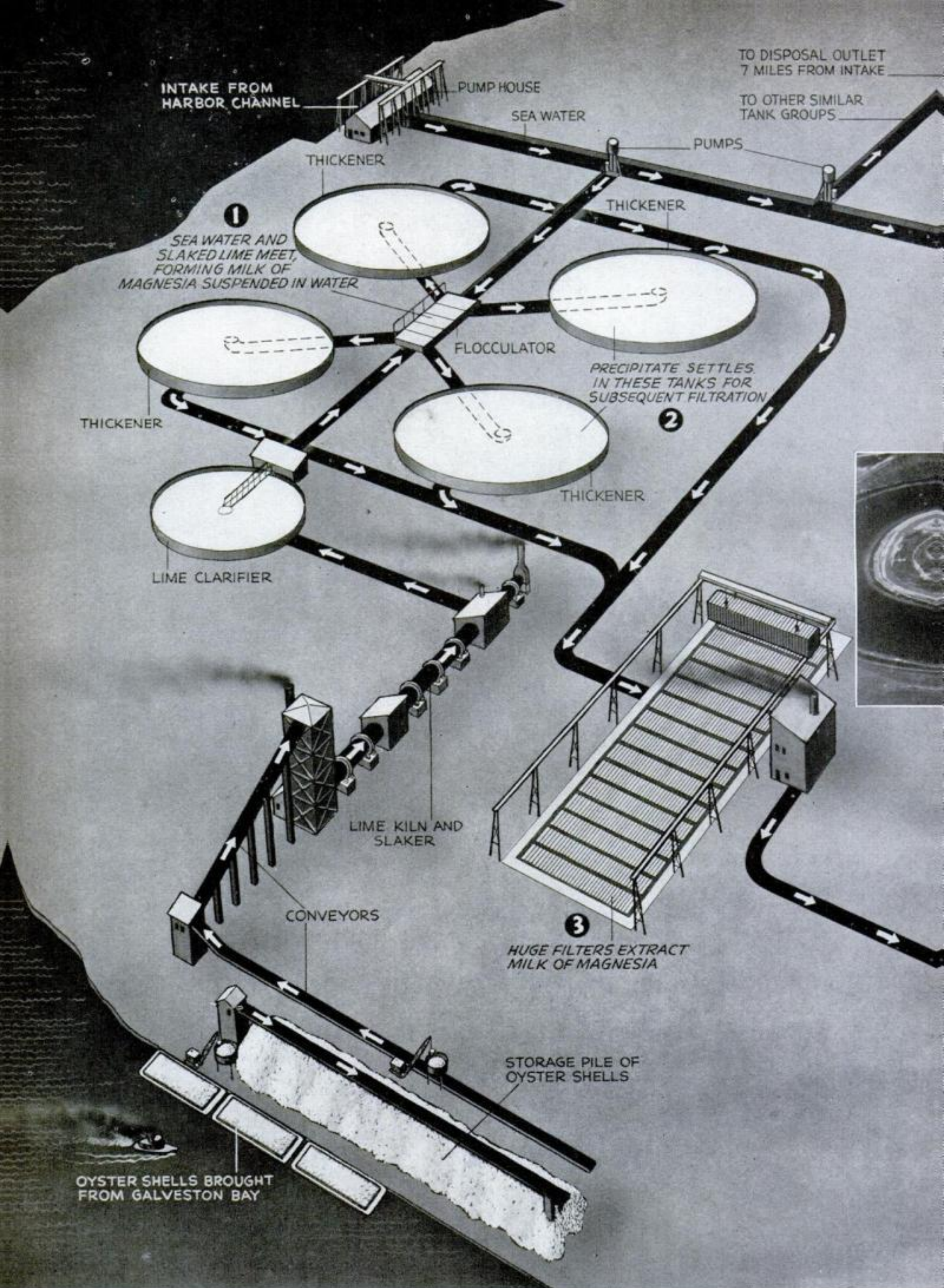
It is fire-resistant, noncorrosive, waterproof, insectproof, impervious to fungus growth, and has a long fatigue limit, withstanding twists, strains, and shakes. Breaks may be cold-patched in the field or hot-patched in the shop.

In addition to the training the gliders will provide, those in the Navy behind the development hold that the scientific advancement in plastic construction has already justified the program. Even the wings and fuselages of future planes they contend, may be improved by the experiment.

Landing on Sea or Ground, the Biggest Outspan Air Liners



Both the big 24-place glider and a smaller 12-place one are amphibious. The larger has a wing span of 110 feet, shown at right in comparison with the Douglas DC-3. The wing span of the other is 70 feet



PICTORIAL DIAGRAM SHOWING THE PRINCIPAL STEPS INVOLVED IN EXTRACTING MAGNESIUM FROM THE SEA. THE LAYOUT OF THE APPARATUS HAS BEEN MODIFIED AND SIMPLIFIED FOR CLARITY

Magnesium from the Sea

CHEMICAL ENGINEERS "DO THE IMPOSSIBLE" TO TAP VAST U. S. SOURCE OF VALUABLE LIGHTWEIGHT METAL NEEDED IN PLANE CONSTRUCTION

BY EXTRACTING magnesium from the waters of the Gulf of Mexico to make lightweight parts for airplanes, engineers of the Dow Chemical Company have become the first in history to "mine" the sea for metal on a commercial scale. A year's operation of a huge plant at Freeport, Texas (P.S.M., Dec., '41, p. 59), has proved the remarkable process a complete success. How

it works has just been revealed to the public.

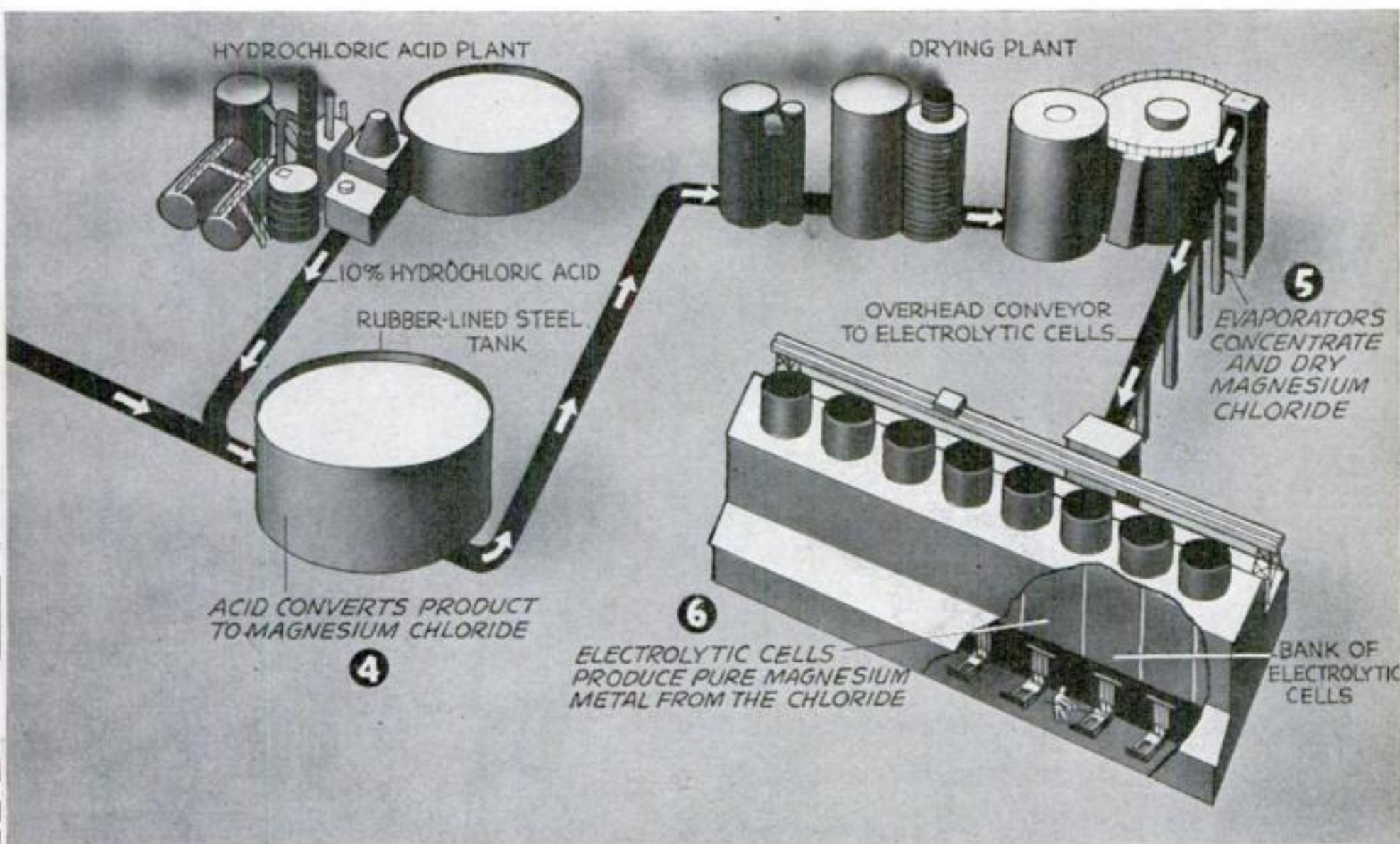
On paper, the scheme requires only three simple steps. First, limewater mixed with sea water converts its soluble magnesium salts into milk of magnesia. Second, treatment with acid transforms this product into magnesium chloride. Finally, electric current passes through molten magnesium chloride, yielding solid magnesium metal at one electrode and chlorine gas at the other.

In practice, the problem is to do this economically. Solid ores of magnesium, such as magnesite, contain as much as 24 percent of the prized metal. In contrast, the brine of the sea holds only 0.13 percent and contains all sorts of impurities from which it must be separated. Making this low-grade "ore" pay



Engineers wrest metal from water on this peninsula in Freeport Harbor

Photos Courtesy of "Mining & Metallurgical Engineering"



its way seemed until now a fantastic dream.

The accompanying pictorial diagram, simplified by the omission of a few technical details, illustrates the major steps. Some idea of the magnitude of the project may be gained from the fact that huge intake pumps at the sea-water inlet handle 300,000,000 gallons daily. Slaked lime is manufactured in a kiln 300 feet long. Lime and milk-of-magnesia tanks in a clover-leaf pattern measure respectively 150 and 200 feet in diameter. Filters with canvas-covered leaves are 90 feet long and are lifted by a 100-ton crane which carries them to an

adjacent compartment where compressed air loosens the cake of milk of magnesia.

Chemical engineering skill has combined natural advantages of the site with ingenious construction. Water pumped into a flume from the Gulf serves both the magnesium plant and an adjacent plant for extracting bromine, a chemical used in making anti-knock gasoline. A river diverted by the U. S. Engineers Corps makes it possible to discharge waste water seven miles from the flume intake so as not to dilute incoming water. Natural gas provides inexpensive fuel. Oyster shells, dredged conveniently near, furnish lime for the kiln. By-product chlorine goes to the hydrochloric acid plant to be used in making more acid.

Construction of the plant on a 2,000-acre peninsula in Freeport Harbor began in March, 1940. Ten months later, the first ingot of metal was poured. In March, 1941, the capacity was doubled. At the beginning of this year, Dow's magnesium output reached 27,000 tons. Now word comes that the Government wants more than double that amount this year. If present plans of the OPM go through, Dow expects to produce more than 60,000 tons of magnesium, or a third again as much as a previous estimate of 45,000 tons for the entire U. S. industry!

At unheard-of speed, airplanes to fight for America and her allies are coming off the production lines. And each new plane, with up-to-date design, needs a little more magnesium than the last. Can America produce enough of the wonder metal to fill the need? With the inexhaustible ocean to draw upon, the answer seems to be yes.



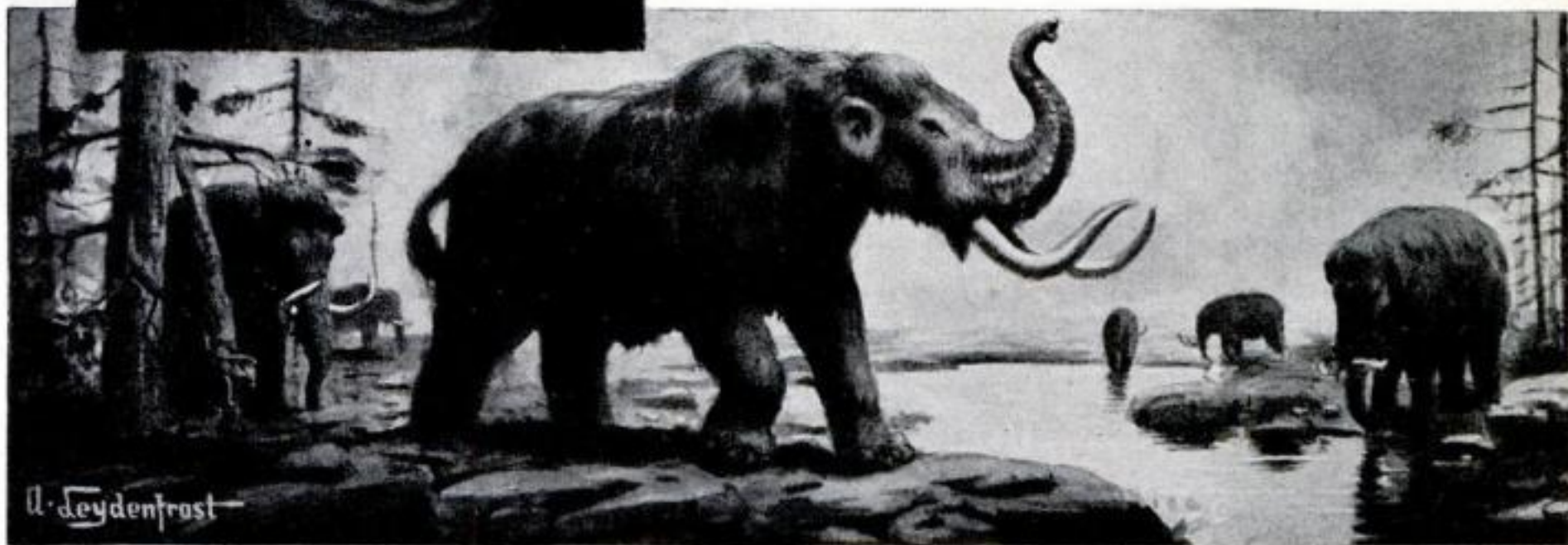
Oyster shells dredged from Galveston Bay reach Freeport Harbor where, converted into lime, they will precipitate magnesium "ore" from sea water

Sea and limewater meet in this clover-leaf cluster of tanks, and the sea yields its magnesium. The tank in the foreground holds limewater, and the four in the background, precipitated milk of magnesia





Cave Machine Helps Find The *First American*



Sandia Man, as anthropologists think he may have appeared, with some of his animal contemporaries. In upper panel: bison, camel, horse, mammoth. Lower panel: mastodon

Archaeologists Stumble Upon the Campfires of Prehistoric Huntmen of 25,000 Years Ago

By ALDEN P. ARMAGNAC

DISCOVERY of the earliest known American has just been reported to the Smithsonian Institution by Dr. Frank C. Hibben, University of New Mexico anthropologist. Sensational finds of weapons and tools, by a party he led to Sandia Cave, N. M., prove the existence there of prehistoric hunters more than 25,000 years ago.

Until now, our "oldest inhabitants" have been believed to be another hunting race, called Folsom Man, whose relics date from a few thousand years later. In fact, it was a quest for "missing links" between Folsom Man and his agricultural and pottery-making descendants that brought Dr. Hibben to Sandia Cave. He found nothing of the sort. Instead, he came upon handiwork of an older-than-Folsom people, now called Sandia Man after the name of the site where the startling discovery was made.

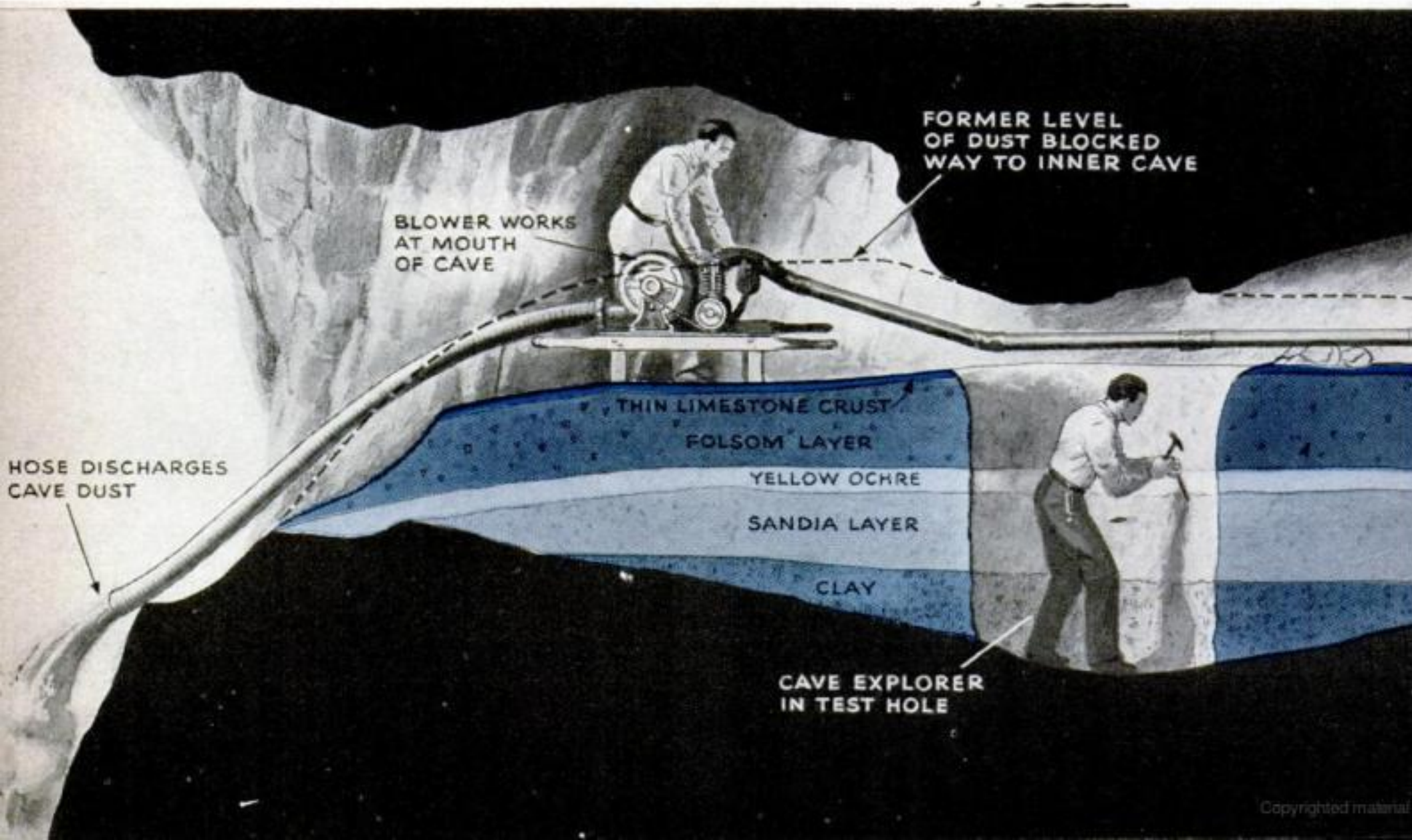
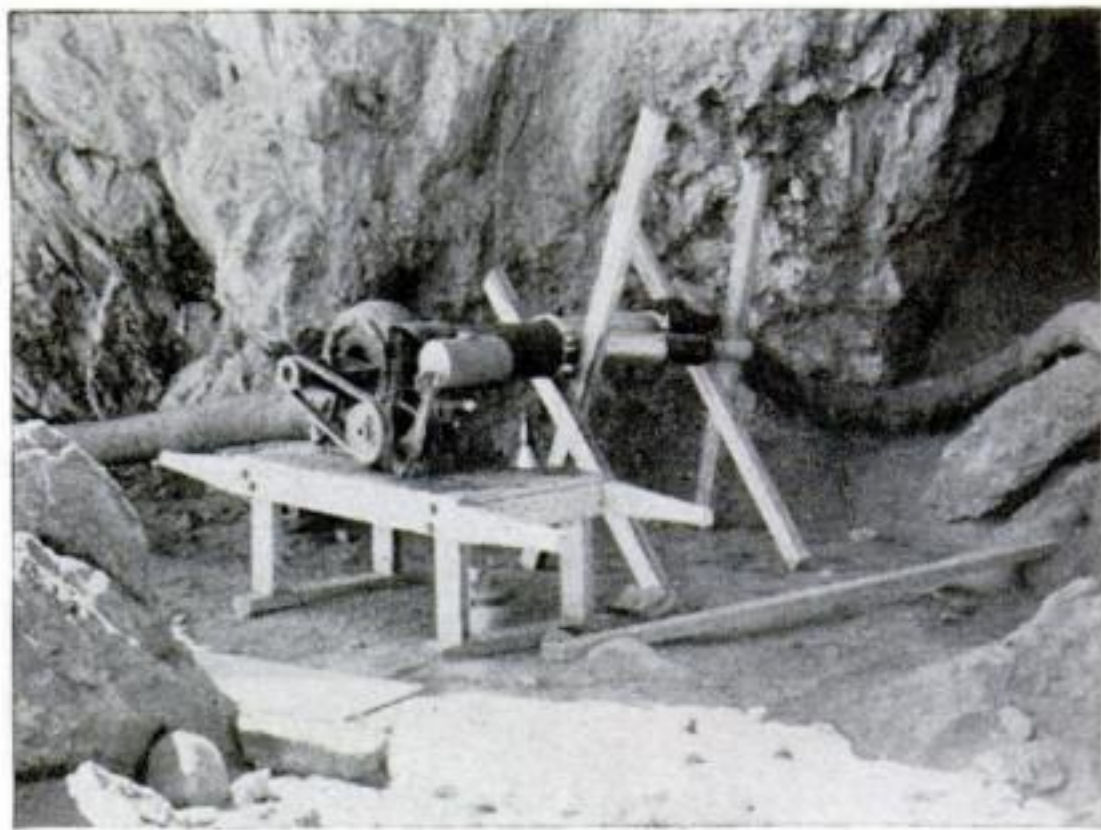
Originally discovered by Boy Scouts, the cavern opens high on a cliff. Wind-blown dust completely blocking the entrance, and piled high within, would have proved a heart-breaking obstacle but for a novelty in the Hibben party's equipment. They set up



Sandia Cave, New Mexico, where relics of the first American were found. Scaffolding seen in the middle background marks its mouth. Below is the entrance to the inner cave, blocked by dust

a gasoline-powered suction blower built especially for cave exploration by Dr. Victor J. Smith, museum director at Sul Ross College in Alpine, Tex. Dust melted away from its intake nozzle in the cave, to be spewed harmlessly from a discharge hose down the cliff. Now to explore, systematically, the sandwiched deposits beneath the thin limestone crust of the cave floor. The top layer would contain the latest material; the next one, earlier; and so on down, as trained archaeologists know. With horror they might have watched the Hibben party go at the first layer with miners' picks, geologists' picks, and even sledge hammers! Delicate methods were out of the question, for dis-

Machinery helps uncover the past: A suction blower that removes dust, saving explorers untold labor



solved limestone had penetrated the layer and hardened it to the consistency of crumbling concrete. Little damage, though, if some of the remains in the broken and screened lumps were shattered. They clearly were Folsom weapon points and other familiar articles of his making.

Deeper went the explorers' test holes and trenches. They struck a relatively soft layer of yellow ochre, evidently laid down before Folsom Man arrived on the scene. No human remnants turned up. The party might well have stopped there and gone home. But they kept on digging. At least the "sterile" bed of ochre proved they had traveled backward, in time, long before the

Expedition members bring up loose material from a test hole, to be examined later for ancient relics



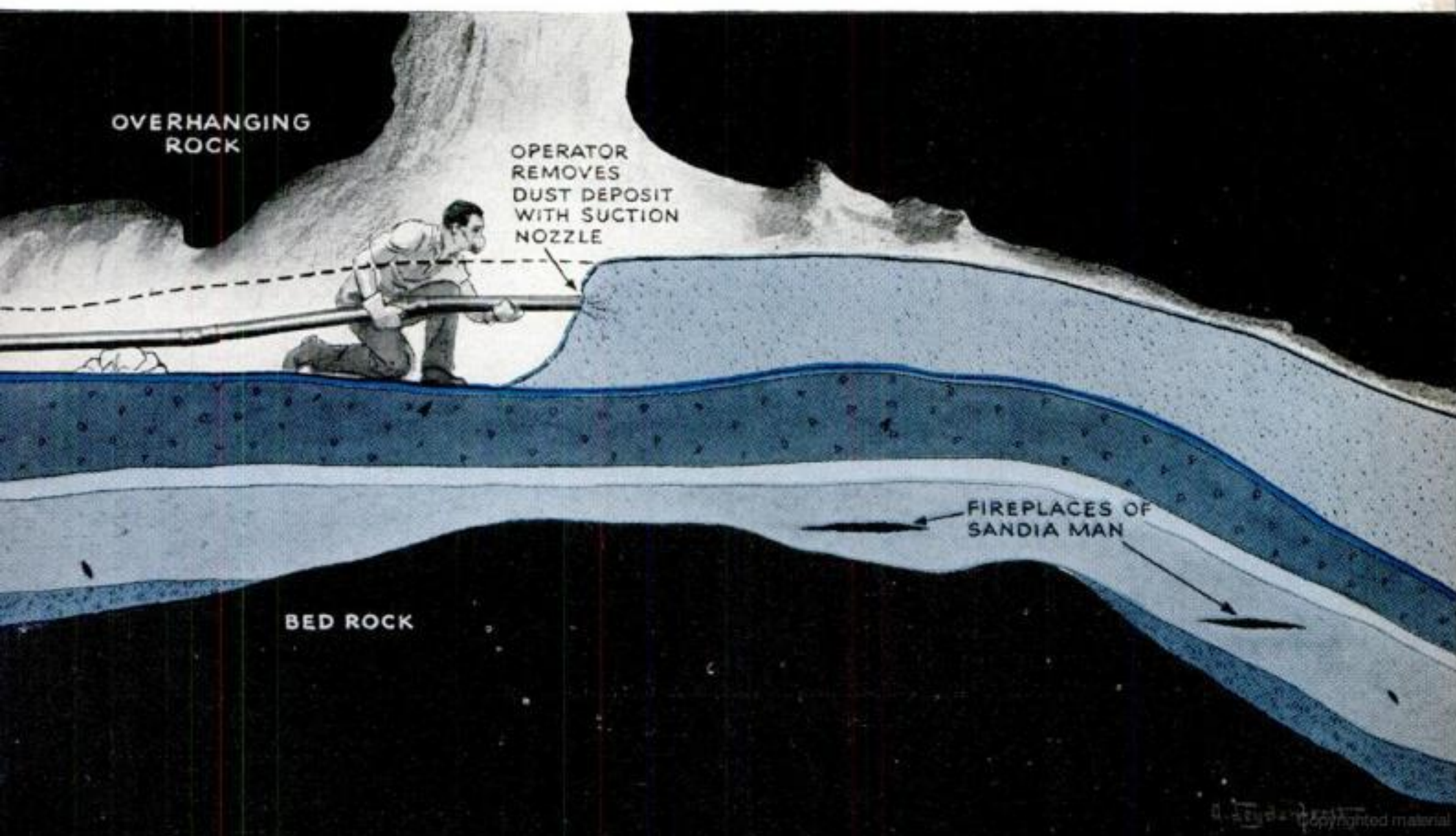
period in which Folsom Man is known to have flourished.

Then, to their amazement, a still deeper layer of man-made remains! Stones ringed a small bed of charcoal—once a fireplace. A weapon point, illustrated on page 78, rested against one of the boulders. Dozens more were found scattered through the debris. There were scrapers, for dressing hides; and knives, chipped from single pieces of flint. All differed markedly from corresponding Folsom objects. Sandia points, for example, bore a characteristic notch at one side; while Folsom points were broadly indented at the base, as shown in the illustration on the following page.

Teeth and bones of animals included mastodons, mammoths, camels, bison, and horses, all of species long since extinct, but contemporary with this Sandia Man. In vain hopes of finding his skeleton, the party excavated underlying clay to bed rock. It was the only thing missing from this treasure trove.

What Sandia Man looked like, however, can reasonably be guessed at, Dr. Hibben informs POPULAR SCIENCE MONTHLY. Compared with early types of the Old World, where mankind had its origin, his physical features were essentially modern. Probably his head was long and narrow, and he had a Mongoloid face. He used his Sandia points on light javelins or spears—many centuries were to pass before some primitive genius

Cut-away view of Sandia Cave shows blower at work, and layers explored. "Sandia" layer contained tools and weapons of Sandia Man, two of his fireplaces, and the bones of many prehistoric animals



invented the bow and arrow. Nevertheless, there is every indication that Sandia Man successfully hunted the larger animals, probably by trapping them in pits or by catching them at a disadvantage on ledges of cliffs. Evidently the cave containing his relics was not his home, but a hunting lodge, Upper Paleolithic style, which he used for short periods of time during forays for food.

How did this remarkable individual get here? Experts consider it extremely probable that the first New World colonists came from Asia, by way of the Bering Strait and the Canadian Great Plains. Until lately, it was held that this crossing must have awaited the final retreat of glacial ice sheets, about 15,000 years ago. Newer evidence, as pointed out by Prof. Kirk Bryan, Harvard University geologist, indicates that there were previous intervals of mild temperature during which the migration could have occurred.

One of these periods coincides with the age of Sandia Man. Thus there exists the strong possibility that he was the original migrant. If so, he was not only the first known American, but the first American in fact!

Folsom Man may have migrated later to the New World; or he may have been a di-

rect descendant of Sandia Man. The same alternatives could account for the remarkable discovery, a few years ago, of the skeleton of a young Indian girl in glacial silts 18,000 to 20,000 years old. That date would allow plenty of time for Sandia civilization to spread and develop into a variety of cultures. And to speed the future tasks of scientists in settling questions like these, machine methods like the blower system used with such success at Sandia cave are now available.

FOLSOM POINT, below, was found in upper layer of cave. Compare it with SANDIA POINT, right, made by the earlier man. Latter is larger, notched at side instead of bottom



Cross section of cave layers: The man's hand rests on the vein of yellow ochre that separates Folsom deposits above from Sandia remains below. Above his shoulder is the cave floor, a limestone crust



AUTOS

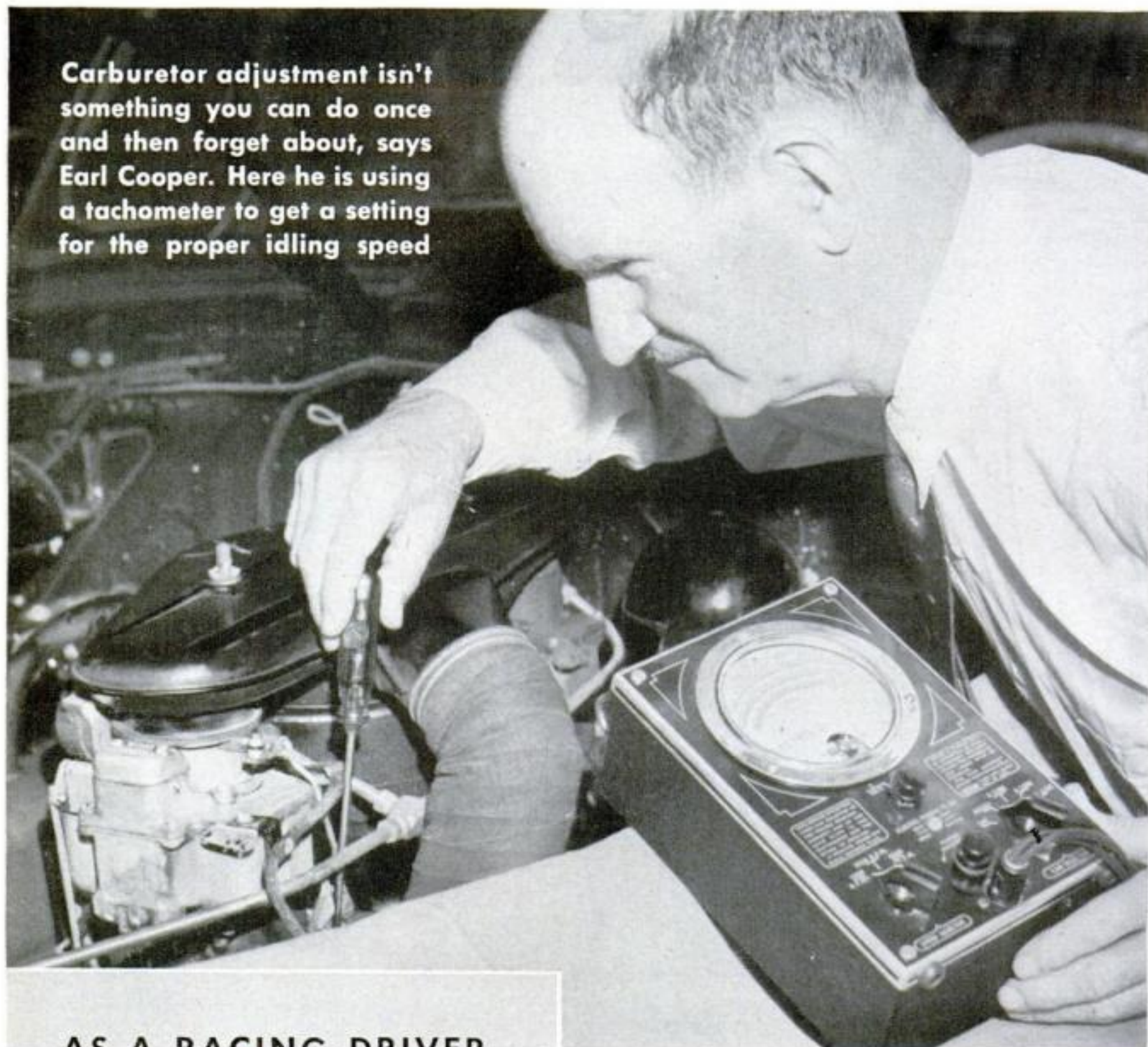


AN EXPERT TELLS-

**HOW TO GET 150,000 MILES
OUT OF YOUR CAR . . . NEXT PAGE**

Modern Cars Are Built for Long Life

Carburetor adjustment isn't something you can do once and then forget about, says Earl Cooper. Here he is using a tachometer to get a setting for the proper idling speed



AS A RACING DRIVER, the author won many big speed events before he quit the track ten years ago. Since then he has worked as an experimental engineer, helping put more miles into cars. Now he tells what you can do.

By EARL COOPER

BECAUSE Uncle Sam needs more and more rubber, fabrics, and metals to build up our military machine, there will not be enough new passenger cars to go around until the emergency ends. So all of us must get more miles from our present cars. Thanks to expert engineering, micrometer-fine assembly, and the availability of oils and greases that will do far more than merely lubricate moving parts, there's no reason why your car, if properly broken in and regularly serviced, will not give you 150,000 miles of safe, comfortable operation. American manufacturing skill and integrity have put the stuff in; it's up to you to get the miles out.

Your problem is simplified if you start with a new car, but you can increase the

life of one which already has been pounding city boulevards and country highways for several years, by following my suggestions. They're practical, too; many motor busses are operated 300,000 miles or more by companies following this general plan.

BREAK-IN. I cannot emphasize too strongly the necessity for care in breaking in a new car. The first 5,000 miles may add 50,000 miles to, or subtract them from, its total life. Ten years ago engines were loose and noisy; now they are tightly fitted, tolerances are close, and hot spots will occur, resulting in scoring or varnishing, unless good oil of the proper weight is used.

Don't drive a new car 40 miles an hour for the first 1,000 miles, then jam the throttle to the floor. Watch the heat indicator as you drive. When it starts to climb above its normal level of 160 to 180 degrees, reduce speed. Maybe next you'll go 60 for a short period. Such changes in pace will wear the little hills on the pistons, cylinders, and bearings down smooth.

Always use the lightest oil possible. Start with oil having a rating of S.A.E. 10, change to 20 at 5,000 miles, then to 30 only when the motor begins to consume more than two quarts per 1,000 miles. Light oil flows faster, especially on cold starts, reaching vital spots quickly. Otherwise, metal scraping against metal widens the narrow bearing

clearances so the heavy oil will reach the trouble spots. Oil not only lubricates; it also washes the cylinder walls and ring grooves, keeps out deposits of gum and varnish, cleans away crankcase soot, and cools the bearings.

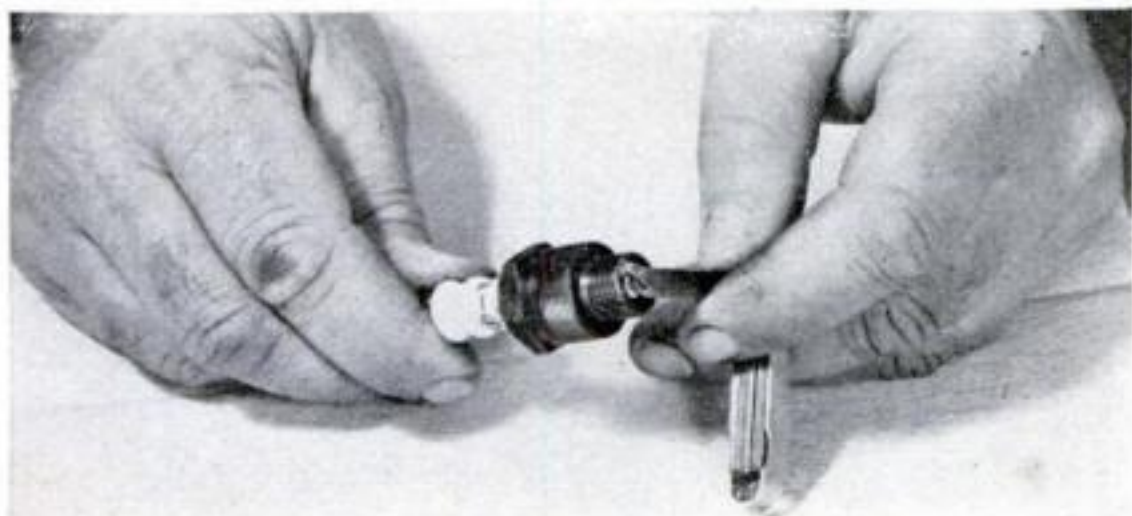
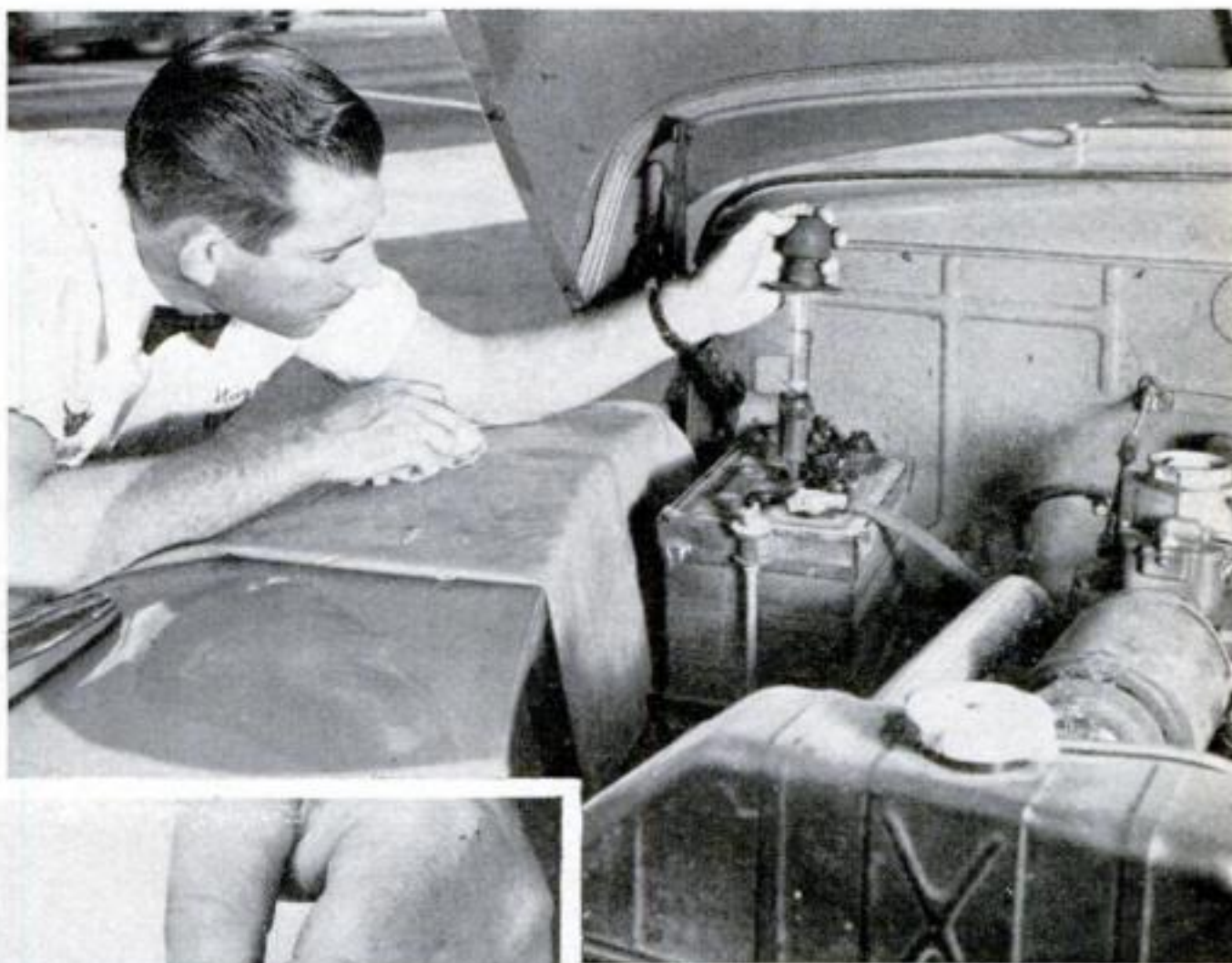
STARTING. Especially in cold weather, have the battery fully charged, a winter-grade oil in the motor, and a volatile, winter blend of gasoline in the carburetor. For icy-cold starts, depress the accelerator to the floor twice before touching the starter button, making an extra charge of gasoline available for the first firing. Now, depress the clutch so the starter won't have to turn over the heavily greased transmission gears. If you don't have an automatic choke, pull out the manual control fully during the first few revolutions while the starter is turning the motor, then push it in half way. Use the choke sparingly after that.

Getting the engine started on the first try instead of the third saves the starting mechanism two thirds of a tough job, and adds just that much to its life. Treat a cold engine with great respect, for a cold, fast start damages the unlubricated parts more than a day of driving when the motor's warm. Accelerate to about seven miles an hour in low, get up to 15 in second, then keep it under 20 in high for the first six blocks.

SPARK PLUGS. Cracked plugs will make

WHAT YOU CAN
DO FOR DEFENSE

Your battery should be tested at least once a month. When both the battery and your motor are cold, it is particularly important that the battery be fully charged, for its output is low and the motor is hard to turn over because lubricants are stiff



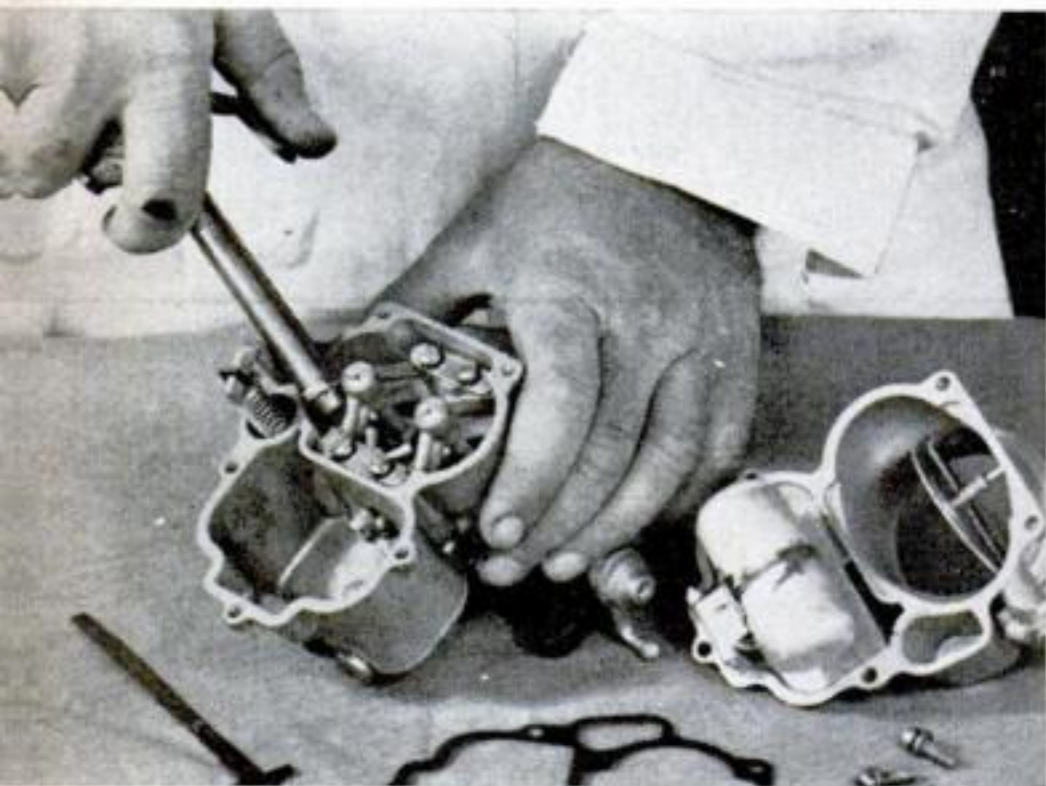
Local car ailments, like human ones, may telegraph trouble elsewhere. Bad plugs may eventually harm bearings. Clean, test, and regap plugs each 5,000 miles

the motor miss. If, after long use, they fire too slowly, not all the mixture in the cylinders will ignite. Some unburned gases will blow by the rings, washing oil from the walls and diluting crankcase oil. Too, worn plugs make starting harder. Test your plugs every 5,000 miles, regapping according to specifications and cleaning them carefully.

BATTERY. A run-down battery which doesn't put out enough power for the igni-

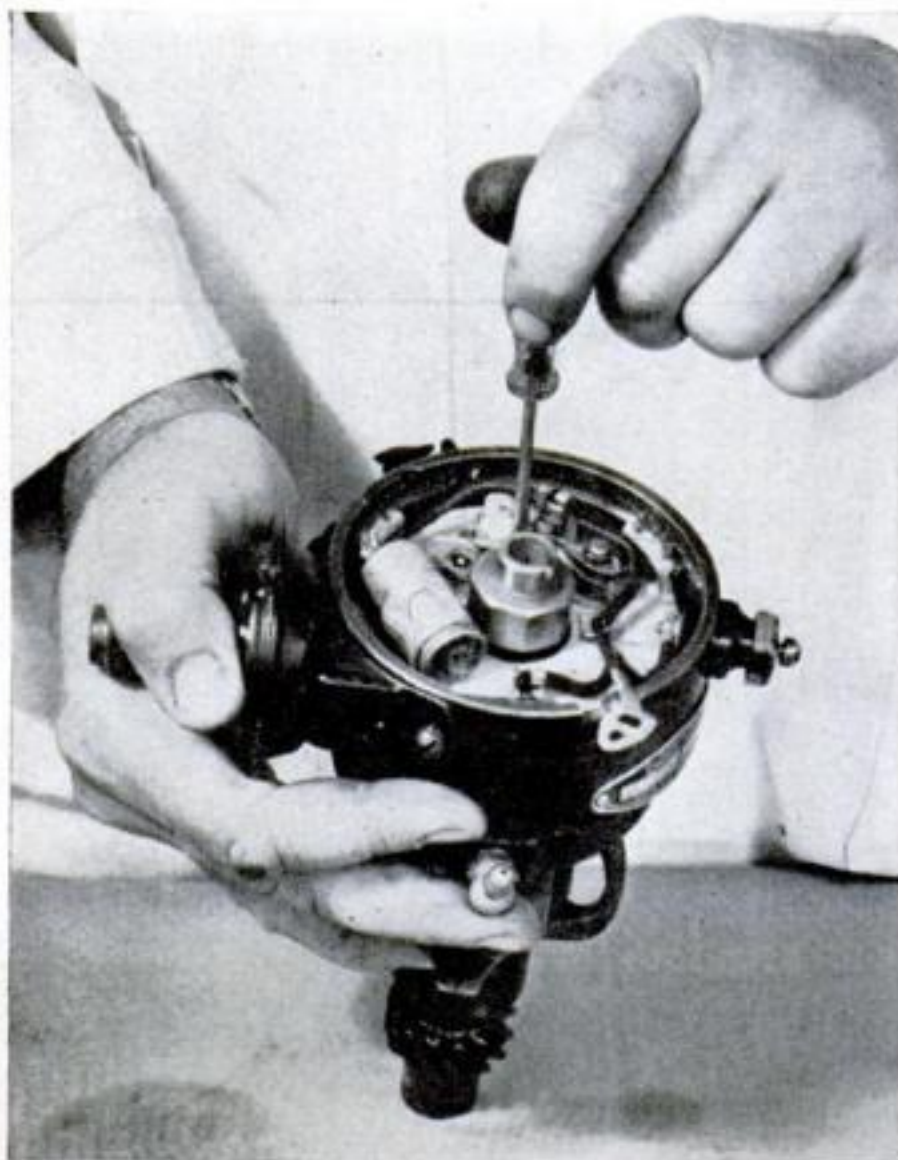
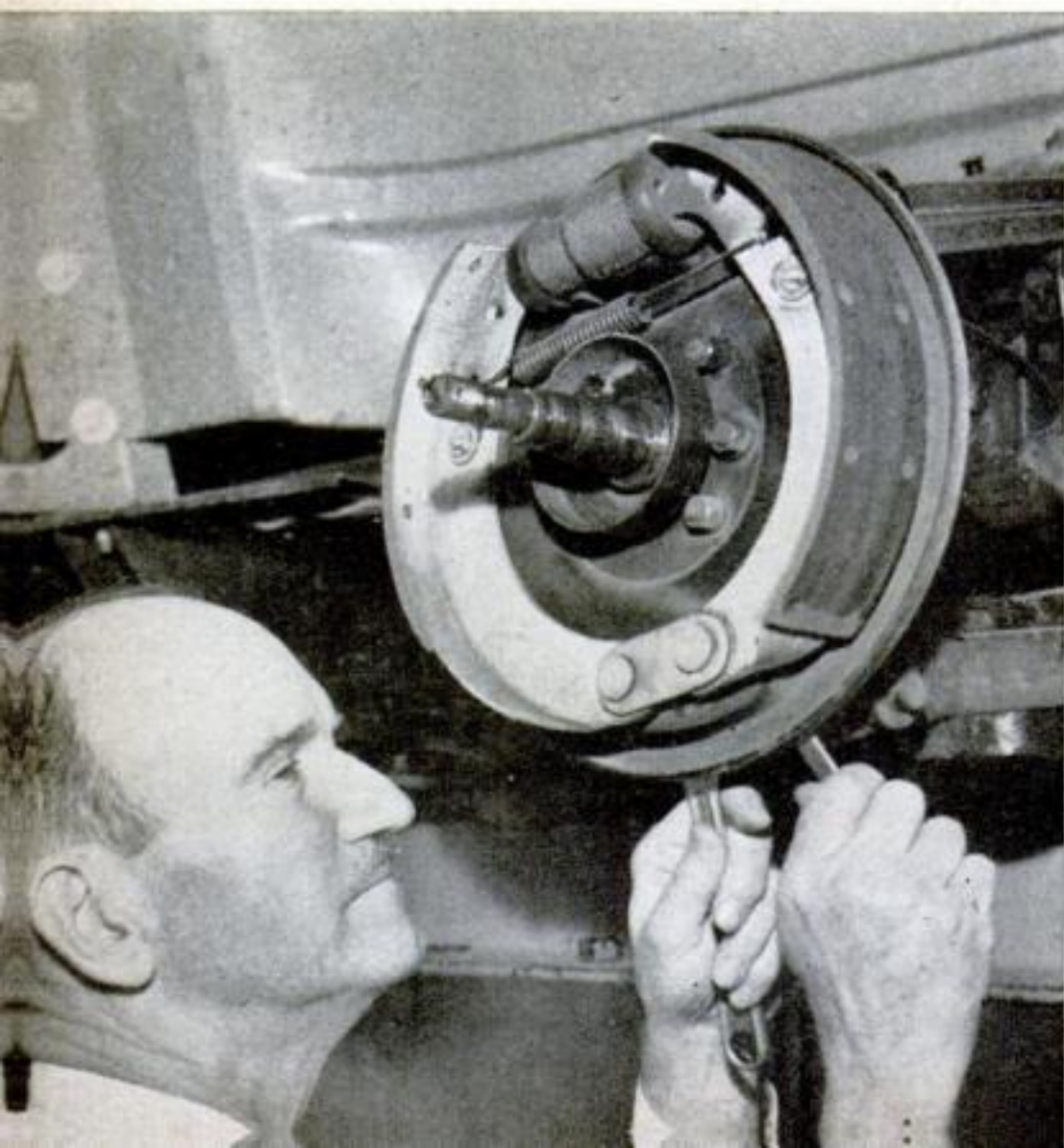
tion circuit gives about the same effect in starting as poor plugs, requiring prolonged grinding of the starting motor.

DISTRIBUTOR. This clearing house for electricity performs a herculean task. Remember, the tiny platinum-and-silver contact points "make and break" 30,000,000 times in 100,000 miles. In time they become pitted, resulting in slower timing and causing the engine to run hotter as the mixture burns



There are many moving parts in a carburetor—which can wear out! Also, jets can become clogged. It ought to be dismantled and cleaned at 5,000-mile intervals, and its jets closely inspected

Brake servicing is done according to how and where the car is operated. Dirt should be cleaned out as soon as possible. Adjustment is needed for efficiency. Never allow linings to wear down to rivet heads



The distributor also should be cleaned and adjusted every 5,000 miles. Its points, if pitted, slow ignition, overheating engine

If you get in water "up to the hubs," or in soft sand or dirt, remove, clean, and repack wheel bearings at once with grease



more slowly or later. That's reason enough for adjusting the distributor every 5,000 miles, replacing worn parts.

CARBURETOR. Some drivers think a carburetor, once properly set, will function properly forever. Don't forget that it also has moving parts that eventually wear out. Too, the tiny jets may become partially clogged with dirt and gums. If blowing with compressed air, or washing in strong solvents, does not clean these out adequately, the air passages must be drilled to the correct size. Poor carburetion results in poor gasoline mileage, heating, and lazy performance. This gas-air mixer should be cleaned every 5,000 miles.

RADIATOR. A dirty, rusty water-cooler causes the engine to overheat and ups repair bills, resulting eventually in shortening the life of your engine. Drain and add clean water at least every six months, or when the water yellows. If this condition occurs, also add a softening compound regardless of the climate in which you live.

OIL AND AIR CLEANERS. Dirt collects in the air cleaners, especially when you drive through sand and dust, and eventually starves the engine. Similarly, bits of metal collect in the oil filter along with other dirt and muck flowing through the lines. These devices serve very useful purposes. The air cleaners should be cleaned regularly, and the oil filter changed with every fourth or fifth oil drain.

TRANSMISSION AND DIFFERENTIAL. Drain and clean oil every 10,000 miles or once a year, whichever comes first. The gears may chip, and these pieces should be removed before they damage the other surfaces. Remember, too, oil in the transmission heats during long runs and tends to thicken, oxidize, and corrode the gears, causing them to become pitted.

BRAKES AND WHEELS. Like changing oil, service here depends upon how and where the car is operated. If you've been driving through water up to the hubs, or in dirt and sand, grit probably has worked into the bearings and drums. Pull the wheels at once, clean out the muck and grease, and re-pack. This grit soon will damage the bearings and cut into the brake drums. Water



Regular greasing, following the manufacturer's recommendations as to type of grease and frequency of applying, is vital to long car life. Don't hesitate to watch the operation. There's lots to learn

tends to emulsify the grease, thus destroying its lubricating qualities.

The entire brake system may be spared undue wear by using the engine's compression when descending hills. Go down hill in the same gear you would use going up. Here's a point worth remembering: If you are going 40 and don't depress your clutch, good brakes will stop the car in 72½ feet, but if you do depress the clutch, 109 feet will be required—a loss of more than 50 percent in braking efficiency.

TIRES. Under normal driving conditions, inflate the tires according to manufacturer's specifications. When properly inflated, actual contact of each tire with the pavement is about the size of the palm of your hand. Therefore, in starting you have only about twice that friction area to get nearly two tons of automobile into motion. In stopping with four-wheel brakes, you have four times that palm-of-hand area. In winter, when driving on icy pavements, apply the brakes medium lightly, alternately pressing and releasing and thus getting a snubbing action. If you feel the slightest skid, release and apply again.

Auto Ideas

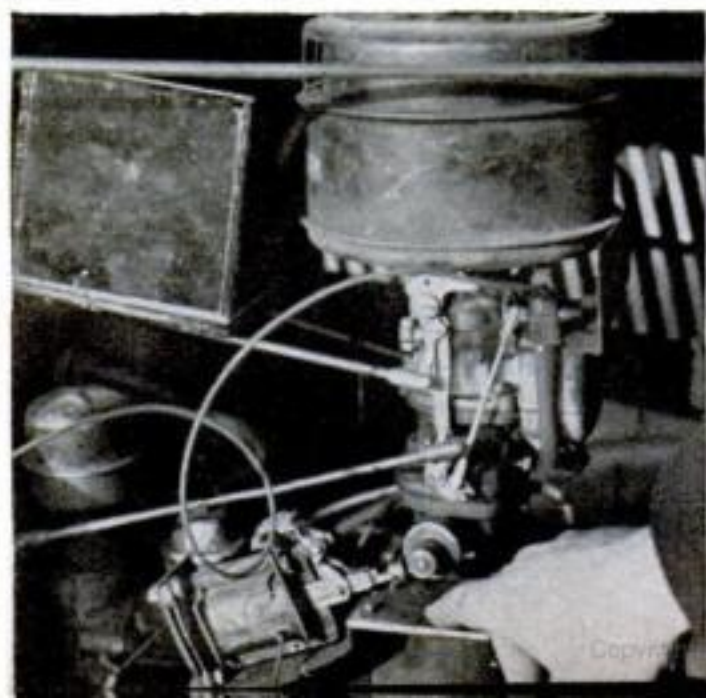
FOG AND FROST-FREE WINDOWS are made possible for cars by paper-thin films that can be applied permanently to the glass. The pieces of film are first dipped in a can of special liquid adhesive and pressed by hand on the inside of windows and windshields. A squeegee supplied with the material is then used to smooth the film and work out any bubbles of air beneath it. After the film dries, the edges are sealed with a thin coat of sealing compound. The films can be removed with hot water.



A NEW FAST-CHARGER for car batteries has large rubber-tired wheels permitting it to be moved about easily. A panel on top of the charger contains all the meters and switch controls. The outfit will substantially charge a normal, run-down six-volt battery in a car in less than an hour. It has a high initial charging rate of 80 amperes, which automatically changes to a lower finishing charge, and then automatically shuts off. Precision-type meters measure the charging rate and the individual cell voltages. A fan-cooled, copper-oxide rectifier is used. High-rate-discharge test equipment is built into the charger, and it compares the voltage of each battery cell before, during, or after charge.

RADIO CONTROLS CAR SPEED at dangerous intersections or other highway points, in a system developed for police use by two Chicago inventors. A portable transmitter sends impulses to any specially equipped car, that will slow down the vehicle when desired even

though the driver steps on the gas. In the photograph below at the left, the inventors are shown operating the transmitter near an intersection, while at the right is a close-up of the receiving unit attached to the carburetor of a test car.



HOW TO ADJUST YOUR CAR FOR A Wartime Fuel

By SCHUYLER VAN DUYNE

WAR brings priorities. And one priority—the vital materials that give the anti-knock qualities to most of our gasolines—may send a lot of motorists to garages and service shops with car motors that are

“pinging” and “knocking.” A change in fuel diet—from high-octane gasoline to one of a necessarily lower rating—will cause the knocks, and the knocks, if allowed to continue, may well result in smashed connecting rods, burned spark plugs, cracked pistons, and ruined bearings.

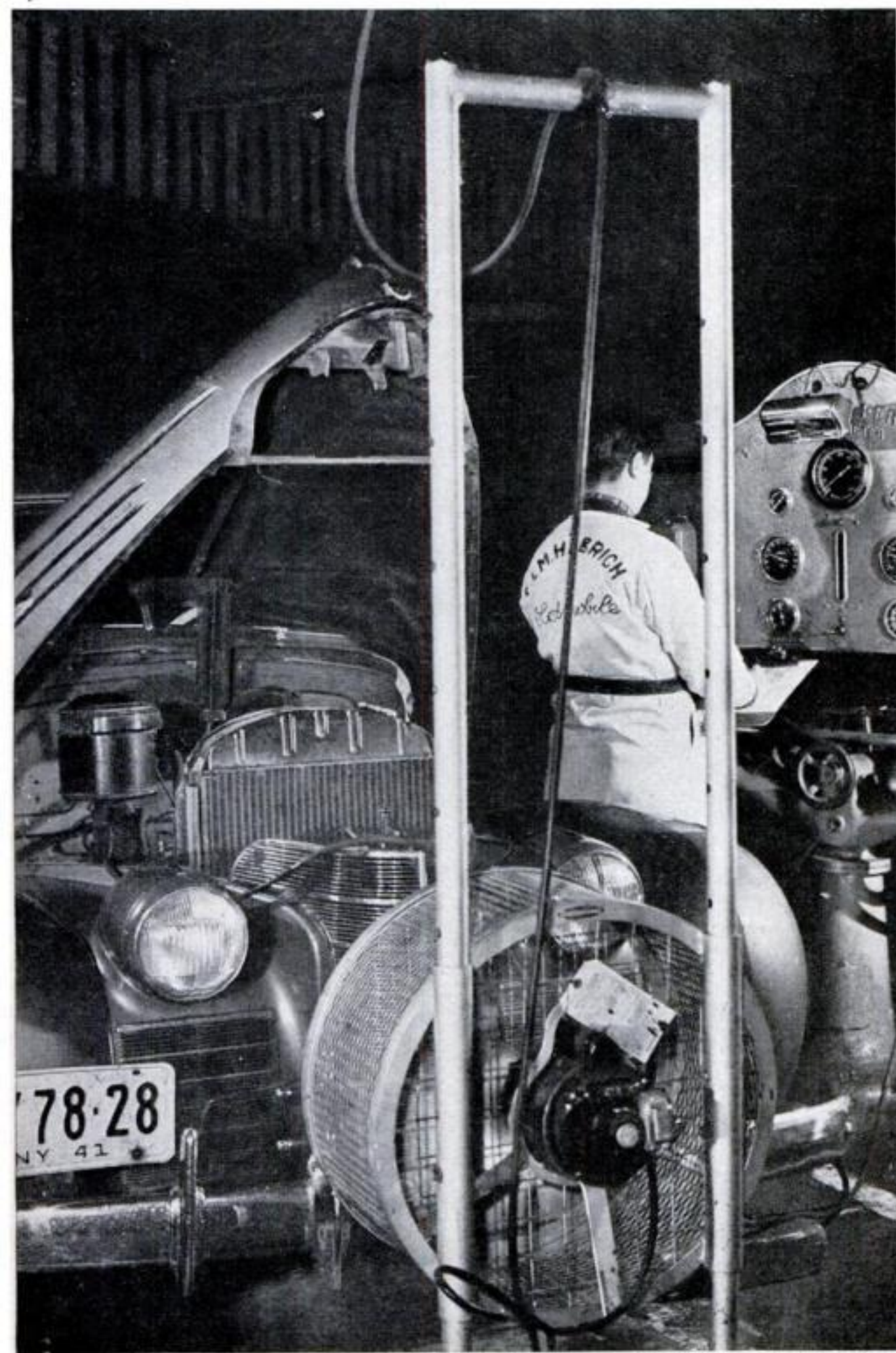
Fortunately, the knocks can be eliminated, even with the threatened poorer gasoline. But the adjustments are critical, and should be made only by expert mechanics who can accurately diagnose the trouble.

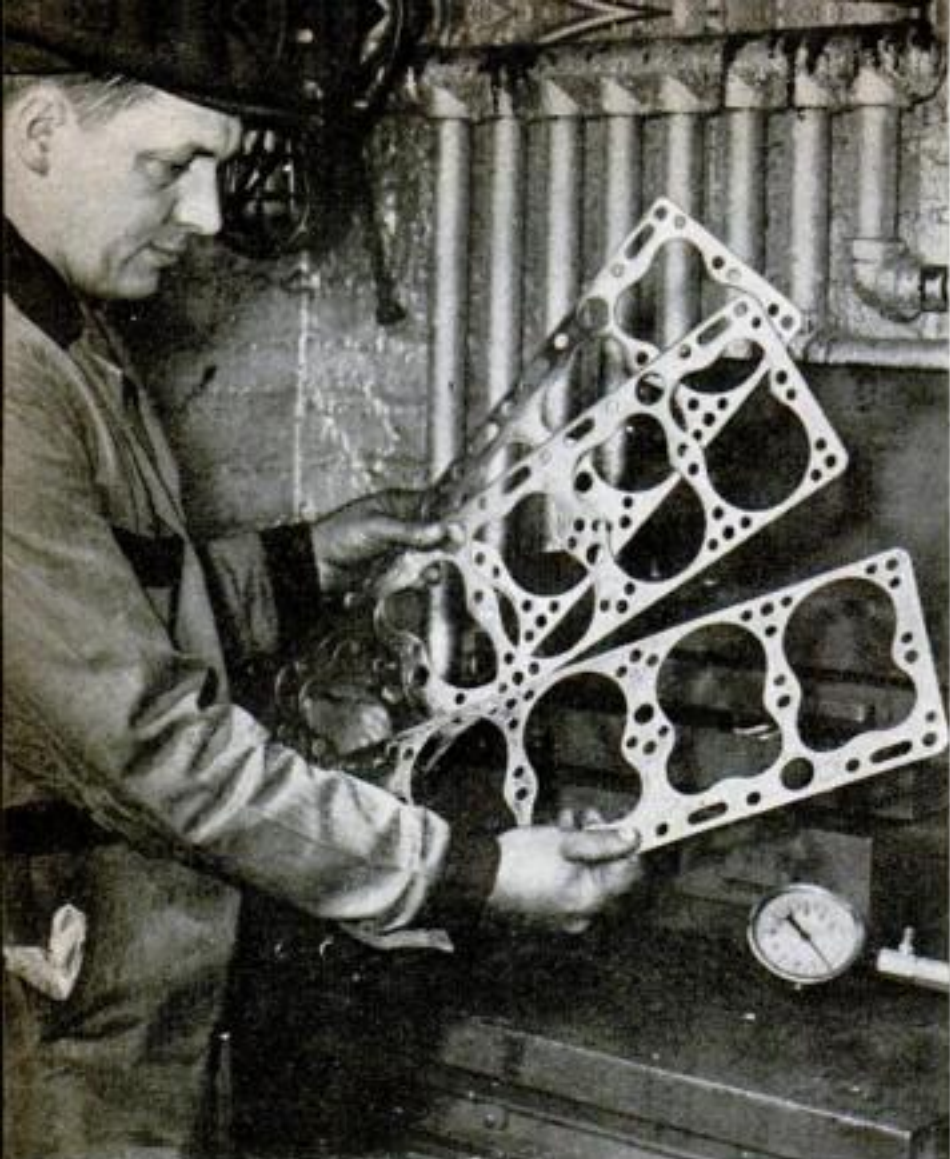
At present, gasoline producers, as well as the manufacturer of tetraethyl lead—the amazing elixir which in minute quantities imparts substantial anti-knock qualities to gasoline—believe that “premium” fuel will not be changed. It currently averages about 81-octane value across the country. The Army has standardized all its vehicles to run on 80-octane gasoline and wants it on hand wherever those vehicles go.

But “regular” fuel, until recently about 75 octane, has already taken a wartime production drop to 72 octane in some parts of the country, because of reduced availability of tetraethyl lead whose critical materials are lead, chlorine, alcohol, and electric power.

While mixing the premium with a substantially poorer regular gas in your own gas tank to get a satisfactory combination has been suggested, it is believed that this would drastically

Tuning up your motor to run without knock on lower-octane fuel is best done with good equipment. Here a chassis dynamometer is recording power output at varied engine speed and load





A very few cars have such a high compression ratio that an extra gasket, or a thicker one, may have to be put under the cylinder head to stop knock



Wise mechanics will adjust distributor points (above) carefully before making a knock test. Other precautions: Clean carbon, adjust valves, test plugs

increase civilian consumption of premium fuel. Either civilian rationing of premium gas, or an arbitrary higher price, might then result. In either case, many motorists would be compelled to drive less. Most probably would prefer to adjust their cars to the plentiful and relatively cheap fuel.

Let's assume it is a couple of months from now, and that the best available gas makes your car engine ping—or worse, knock—on a pick-up or a hard pull. The noise is the telltale of trouble. With a motor tune-up tester, or a chassis dynamometer, your authorized dealer or reliable tune-up shop will, in the great majority of cases, find that it comes from improper timing of the ignition distributor to the knock-tendency of the new gasoline. If so, you are lucky. For every car's distributor has a timing adjustment. It is the same thing that old-time cars had on their steering posts along with the hand throttle. On some cars there is a convenient thumbscrew to turn. On others a clamp is loosened to permit a slight turning of the entire distributor housing. You should set it back—retard the spark—to the point where dangerous knock is eliminated.

Let's assume now that you are *not* one of the lucky majority whose cars can be made to run damage-free by a simple timing adjustment. The dynamometer and an exhaust-gas analyzer show that even with the spark retarded to the limit the knock continues because the mixture is too lean.

Important, too, before adjustments to changed octane ratings, is uniform compression in all cylinders. Unequal pressures mean sticking valves or bad rings



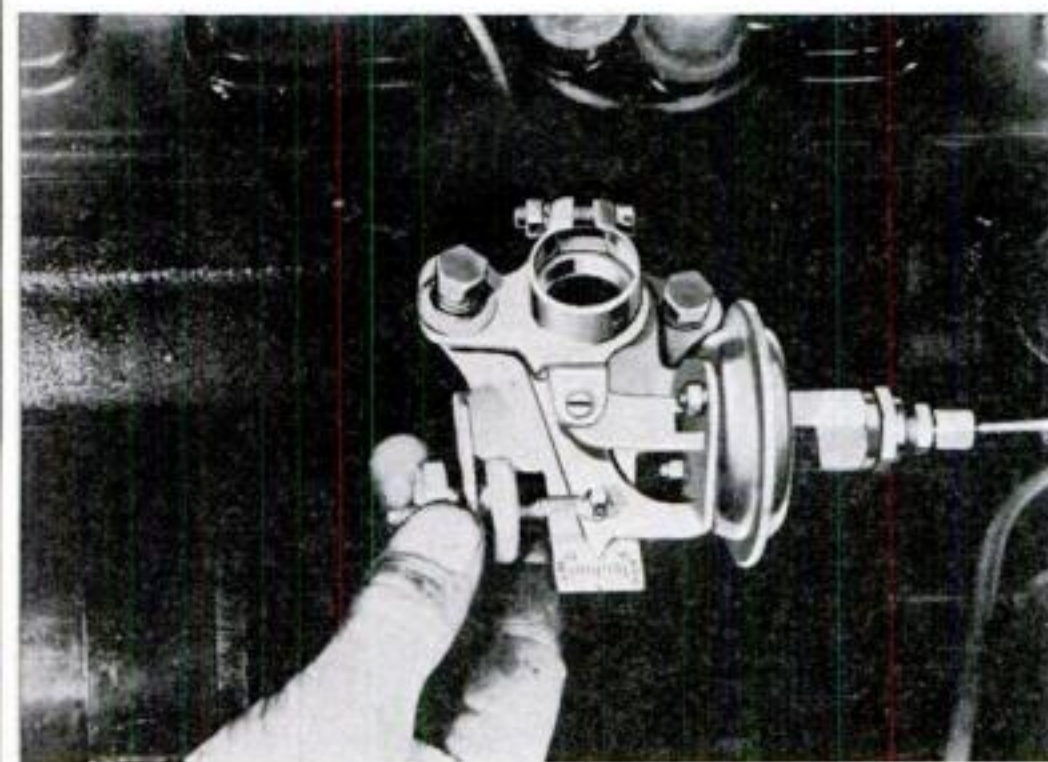
Except for idling speed, carburetors have no handy adjustment. To make the fuel mixture richer for operating speeds, you must substitute jets with larger openings. Determining the highly critical size of new jets calls for a lot of automotive wisdom. Pick a wise and expert workman who has good engine-testing equipment if you suspect that you are in for this particular trouble. And remember that when the new jets are installed it will still be necessary to readjust the distributor to suit the new mixture of fuel.

There is a third form of grief that a few



You may need a richer carburetor mixture to eliminate knock. Only way to get this, for driving speeds, is to install larger jets. It is a job for experts!

Most cars will need only a retarded spark if engines are in good shape. A knob or similar adjustment on distributor base (below) makes this an easy matter



car owners may experience. Their cars were designed to run on premium fuel only, of 80 octane and no less. Generally, these are the cars with extremely high compression ratios, cars that have been built in the last two or three years. The remedy for these is to lower the compression ratio, which can be accomplished by removing the cylinder heads and inserting additional gaskets, or thicker ones. When the time comes, car makers will inform their dealers as to desired thickness of the new gaskets.

But new gasket thickness will set up new operating conditions in such a motor. The

timing must be readjusted from scratch and, that failing of complete knock elimination, the carburetor jets changed.

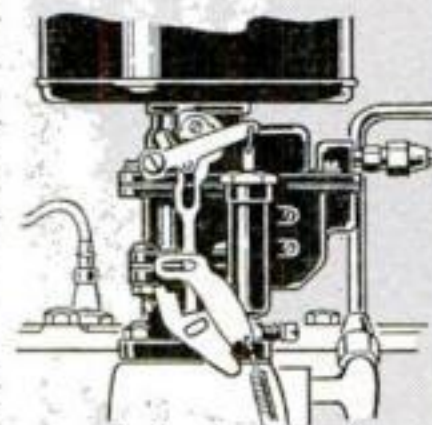
Before you get too alarmed over knock, several points should be remembered. To begin with, a slight ping when you step on the gas hard does not always mean trouble. Many good mechanics adjust timing so that ping will occur under heavy engine load. If other mechanical conditions are correct, that often is the point where most motors deliver maximum efficiency and power. Again, a car driven 10,000 miles or so under average conditions may begin to ping under load, even though originally set to avoid it, because carbon has formed in the combustion chamber reducing its volume and automatically raising compression ratio. For a host of such cars, cleaning out the carbon will help a lot.

Certainly there are no gasoline cars, trucks, or busses on the road today that any anticipated lower octane gasoline will make unusable. Perhaps the soundest advice to follow is to get your car motor in the best possible running shape now, before the fuel change comes.

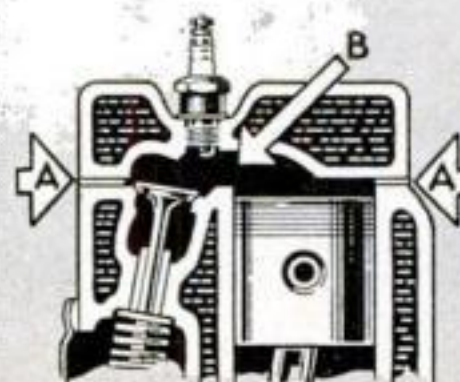
THREE WAYS TO STOP ENGINE KNOCK CAUSED BY LOWER-OCTANE GASOLINE



DISTRIBUTOR. It's the first thing to tackle if wartime fuel of reduced octane value makes your car knock. Retard the spark to stop knock. If retarding to the limit of its adjustment does not help, an expert must attend to the...



CARBURETOR. The problem now is to make the gasoline mixture richer. The only way to do this is to replace the jets with larger ones. Any change here is critical. Your dealer or a highly qualified specialist should do the work



COMPRESSION RATIO may have to be reduced, if all other measures fail. Again requiring great precision, it means inserting a thicker gasket (A) under the cylinder head to increase the size of the combustion chamber (B)

New Life for Old Engines

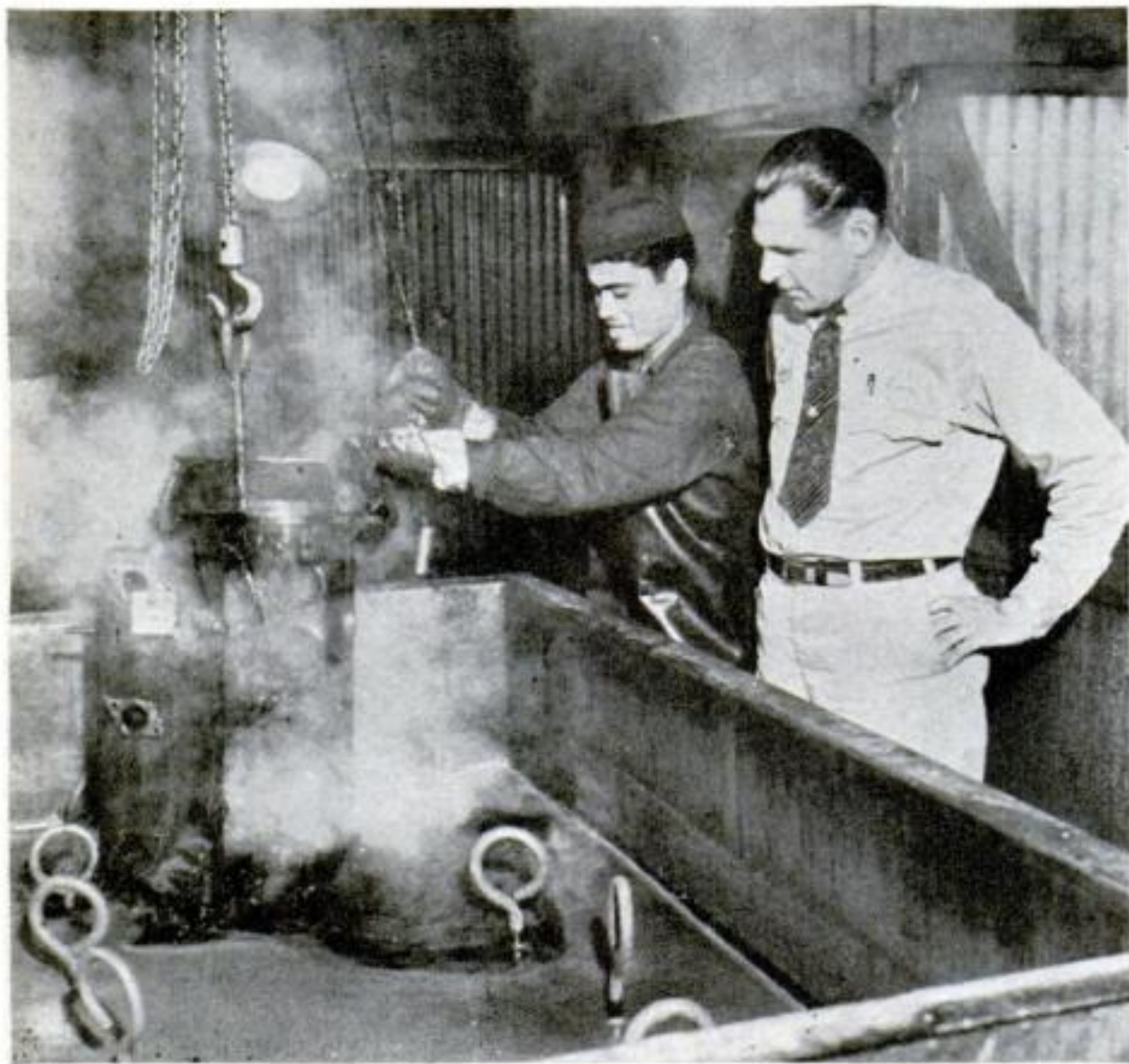
Louis Meyer, Famed as Racing Driver, Returns to Tinkering and Converts 1,800 Worn-Out Motors a Month into New Ones

LOUIS MEYER, whom a million fans know as the first professional driver to win the 500-mile classic at Indianapolis three times, used to tinker with jalopies when he was a kid in South Gate, Calif., and went from there to win fame and fortune behind the wheel of a racing car.

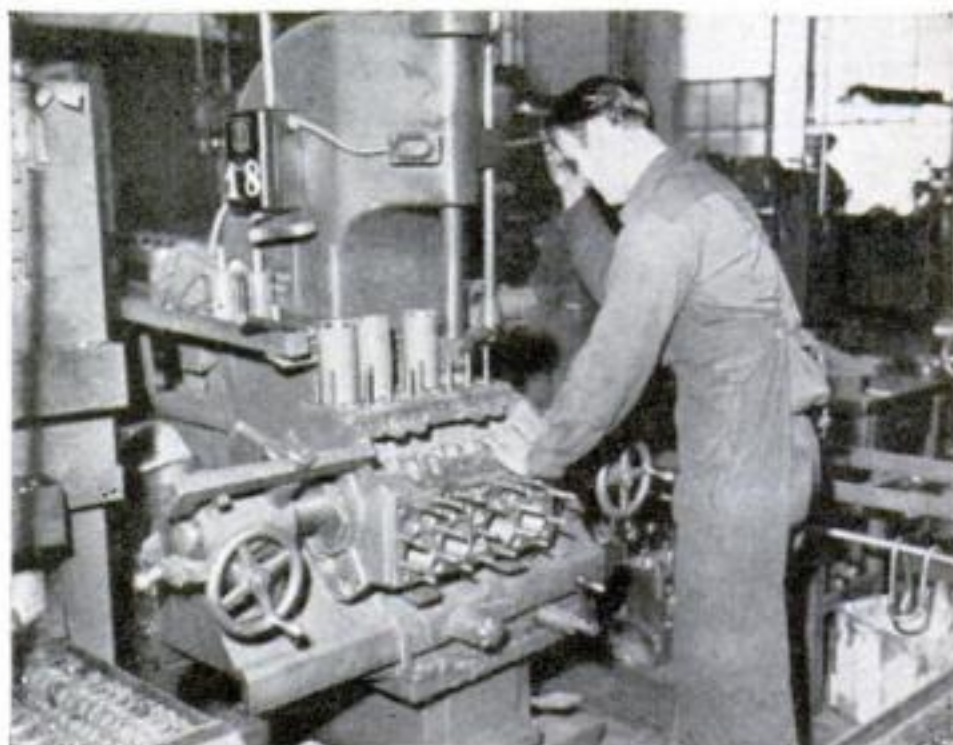
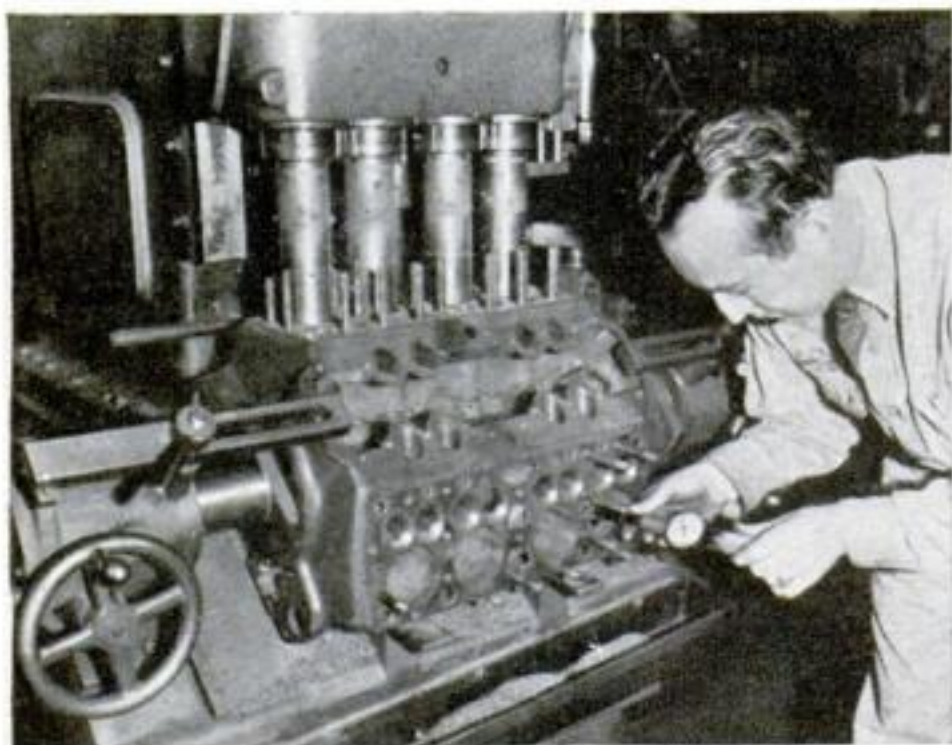
He retired two years ago, began tinkering again, and today, in a rambling building on the edge of industrial Los Angeles, Meyer rejuvenates 1,800 ailing motors a month. Worn-out motors come to Meyer from 644 Ford and Mercury dealers in nine western states and in foreign countries, and return home almost as good as 1942 models.

When motors arrive, they roll down a disassembly line—an assembly line in reverse—where mechanics remove all parts and send the blocks to a cleaning tank. Chemicals eat at the accumu-

In tanks of chemicals heated and agitated by steam, engine blocks are cleaned for three and a half hours. At left, Meyer oversees the start of this step in reconditioning



Engines are rebored, all four cylinders of one bank being done simultaneously. As the boring machine operates, workmen "mike" other cylinders, as at left, to determine the amount of reboring needed. At right, hard-steel sleeves are placed in the rebored cylinders to permit the use of new standard pistons





Carburetors by the thousand are rebuilt as one step in the assembly-line method that speeds rejuvenation of old motors in Meyer's garage run on big-business scale

lation of dirt, grease, and rust, leaving a block as clean as a hound's tooth. It is ready, after minute examination, for a rapid trip along the rebuilding lines.

The first steps are painting, then tagging with a label reading: "Genuine Ford Reconditioned Engine Assembly." Further down the line a four-spindle boring bar rebores cylinders. Mercury engines are bored and honed, while Ford engines, after boring, are fitted with hardened steel sleeves, which double the cylinders' lives between overhauls.

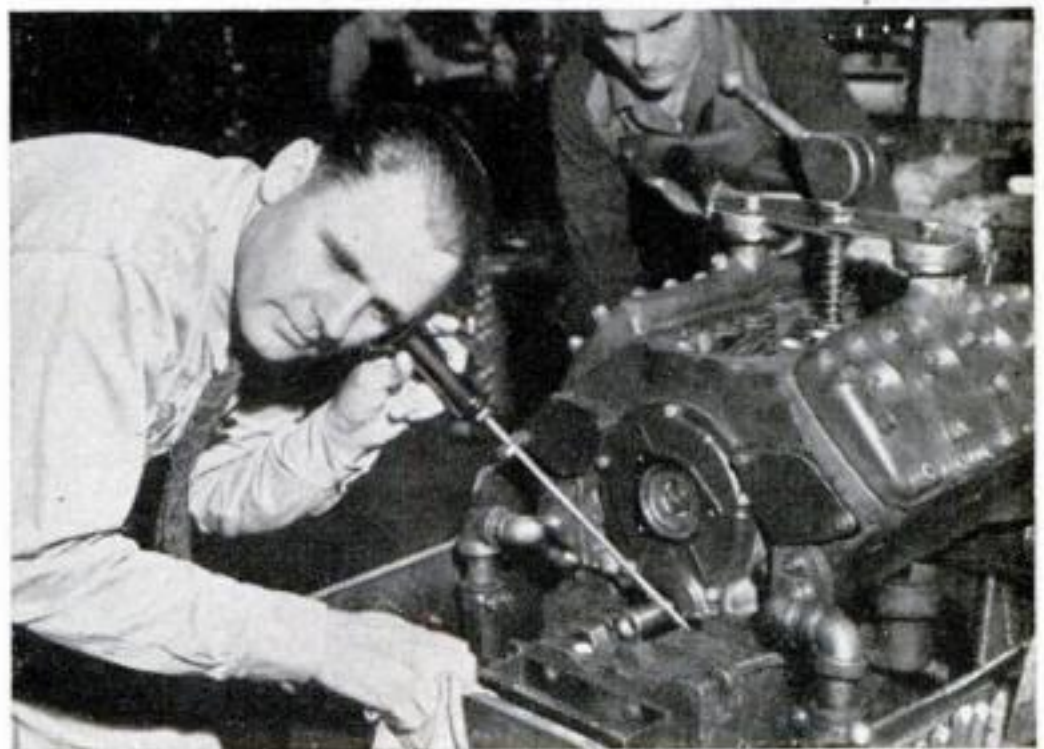
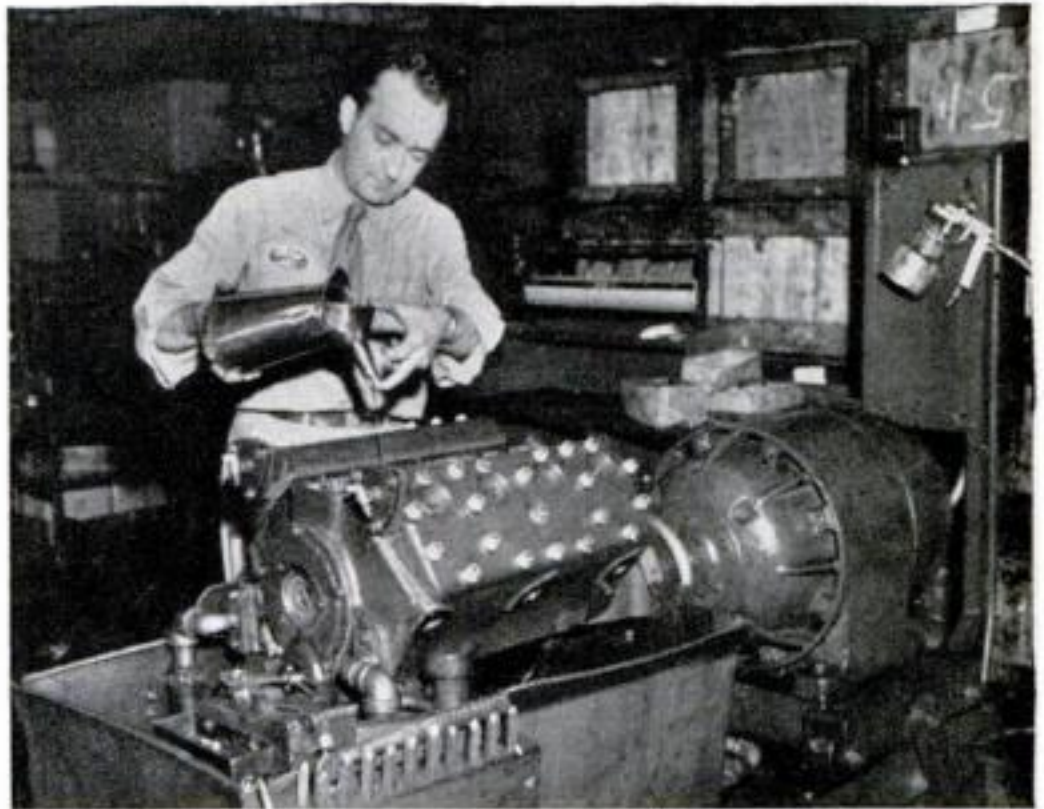
From a gritty mess at 8 A. M., an engine by afternoon has its reconditioned crankcase bolted in, its pistons fitted, and its clearances measured. New rings are assembled on new pistons, which are fitted to renovated rods. Cylinder heads are installed and, as the last bolt is tightened, workmen begin to check oil pressure and bearing clearances. Each operation has been double-checked by experts when the reassembled motor is ready for testing for interior noises. Pronounced right at last, it is stamped by swift hands with the date, sprayed with rust-preventing oil, crated—and a com-

After final assembly, a rebuilt engine is hooked up to an electric motor and tested. During this operation, oil is poured into the cylinders to lubricate the pistons and rings. Below, Meyer, a stickler for accurate workmanship, listens, through a telephone receiver and metal rod touching the timing-gear cover plate, for interior motor noises

pletely rejuvenated motor starts for home.

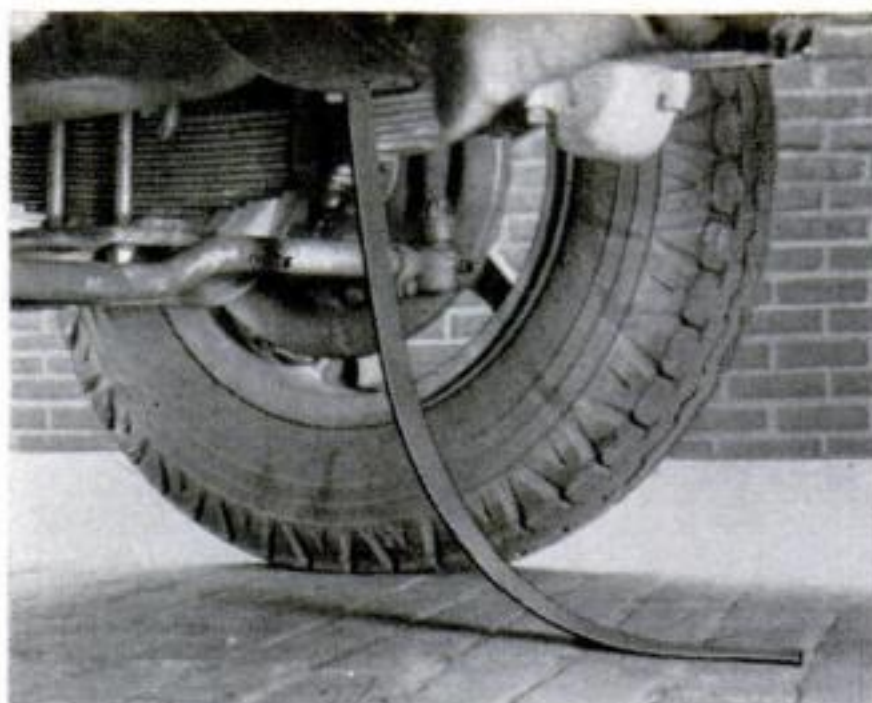
After several months at the Ford plant in Dearborn, Mich., learning to make parts and assemble Ford engines, Louis Meyer returned to California to make new motors from old, using the new methods developed by Ford. Business increased rapidly and he was forced to triple floor space. Front-office problems also increased for Meyer, as company president, but he has never neglected his shops. "I'm just running a garage—on a large scale," he says.

From racing experience, Louis Meyer knows that precision workmanship saves motors—and lives. He knows too, that expert reconditioning will prolong the lives of automobiles and trucks and thus save raw materials vital to conducting the war. A rebuilt engine, Meyer holds, requires about a fiftieth of the metal that goes into a new one.



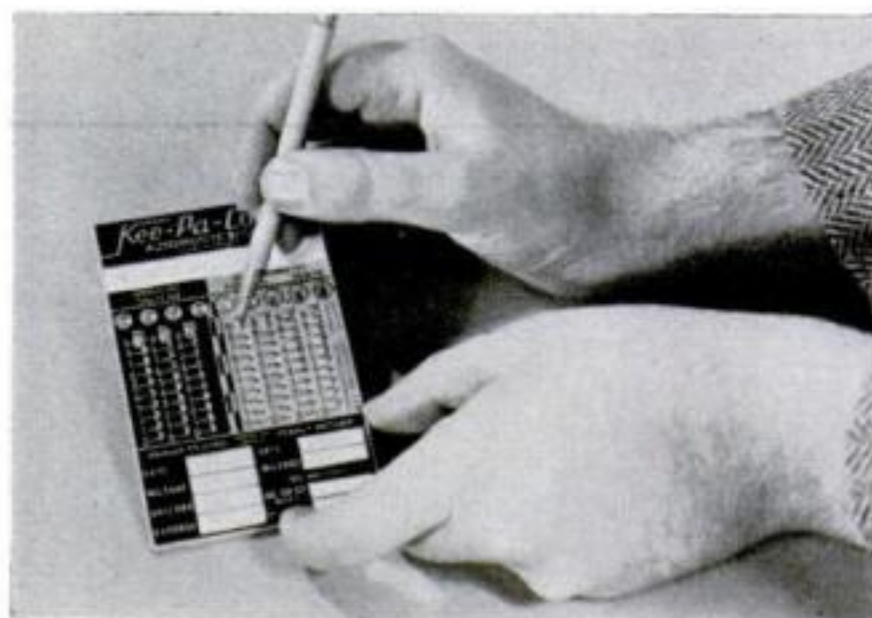
Auto Ideas

STATIC GROUNDERS for fuel trucks are being made of a special rubber compound which conducts electricity and is said to outlast the conventional metal chain. Quietness is also a feature of the static dissipators, which are 1½ inches wide by 30 inches long. Handy eyelets speed installation.



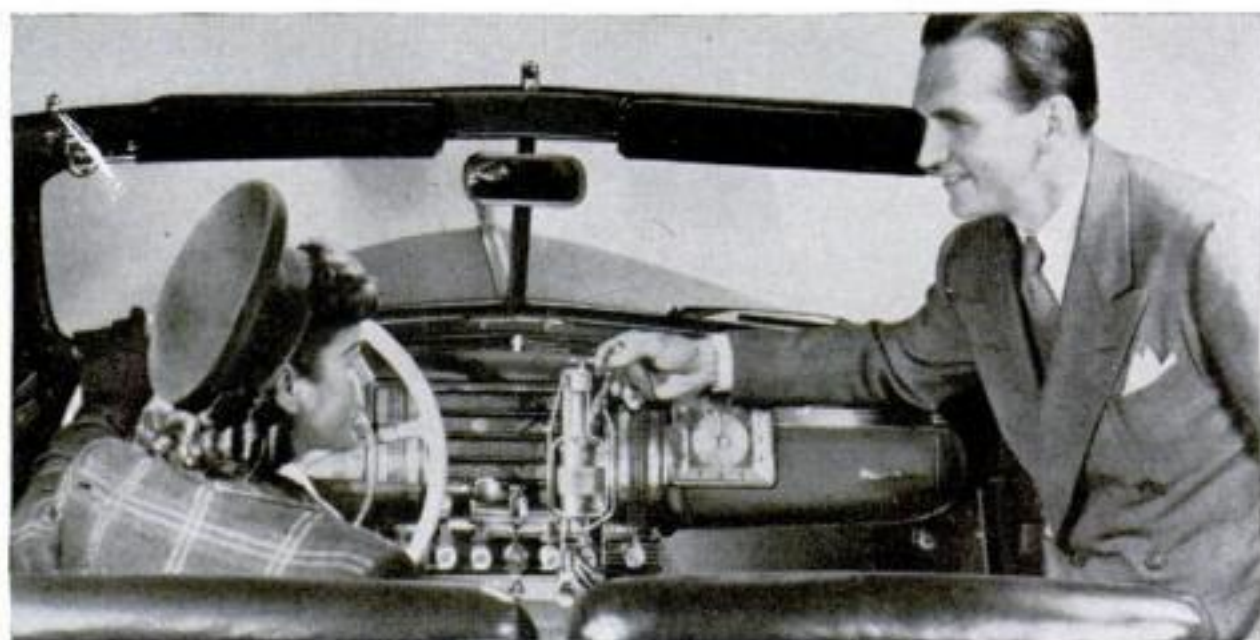
RAPID VALVE-SEAT GRINDING is possible with the new vibration-type unit illustrated in use above. Light, compact, and constructed to reach hard-to-get-at valve seats, the dry-grinding machine is said to give an accurate mirror finish. It is available for car, truck, or bus engines, including internal-combustion engines of the Diesel type.

AN ADDING MACHINE for your car, to register operating performance and costs, keeps an accurate record of gas, oil, and other expenses. After a simple operation, it automatically adds their totals at the end of a day. It clips easily to a sun visor.



WATCHING GAS FLOW to the carburetor during a demonstration drive, prospective purchasers of Dodge cars are shown just how far the car will go on a tenth of a gallon. Flow-

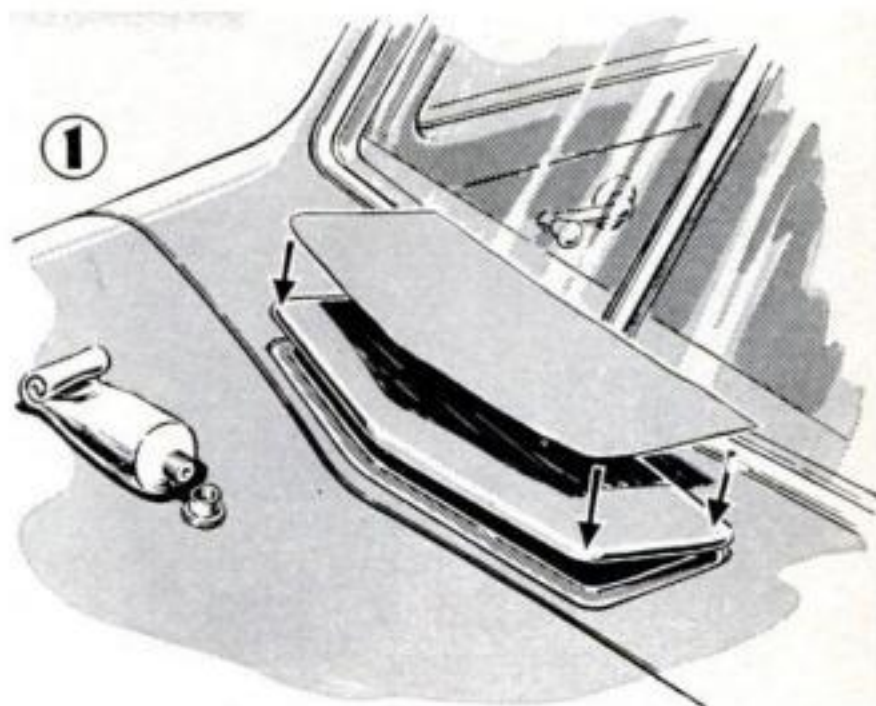
ing fuel can be observed as it leaves the transparent dashboard container, and miles per gallon can be computed by multiplying by ten the distance covered on a containerful.



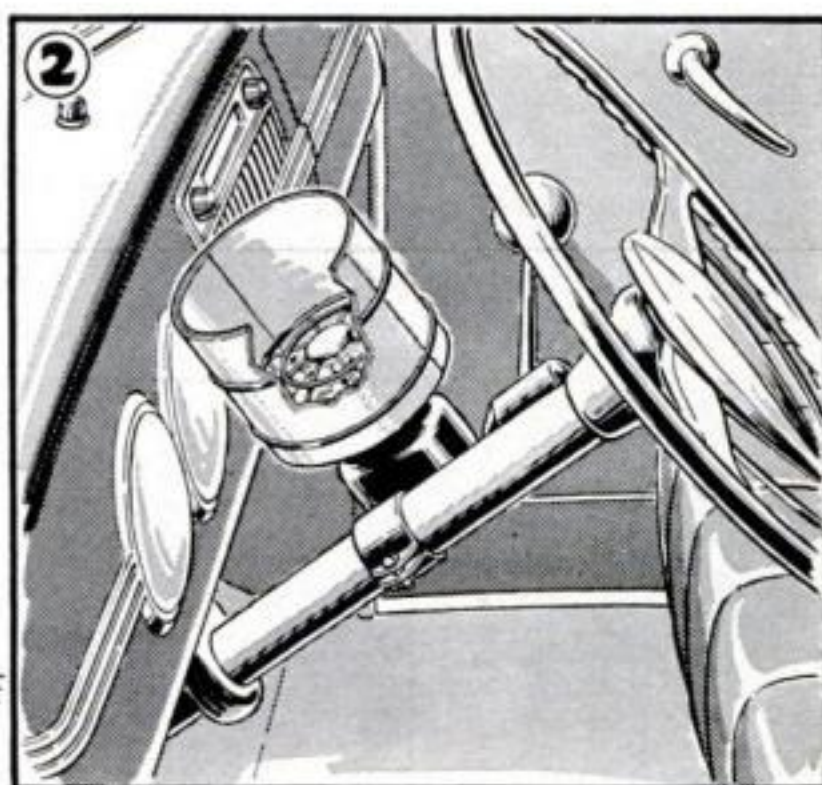
Left, close-up of the tenth-gallon unit that fastens to car dashboard, as above, to let a prospective buyer see just how much gas a car uses

MOTORING HELPS

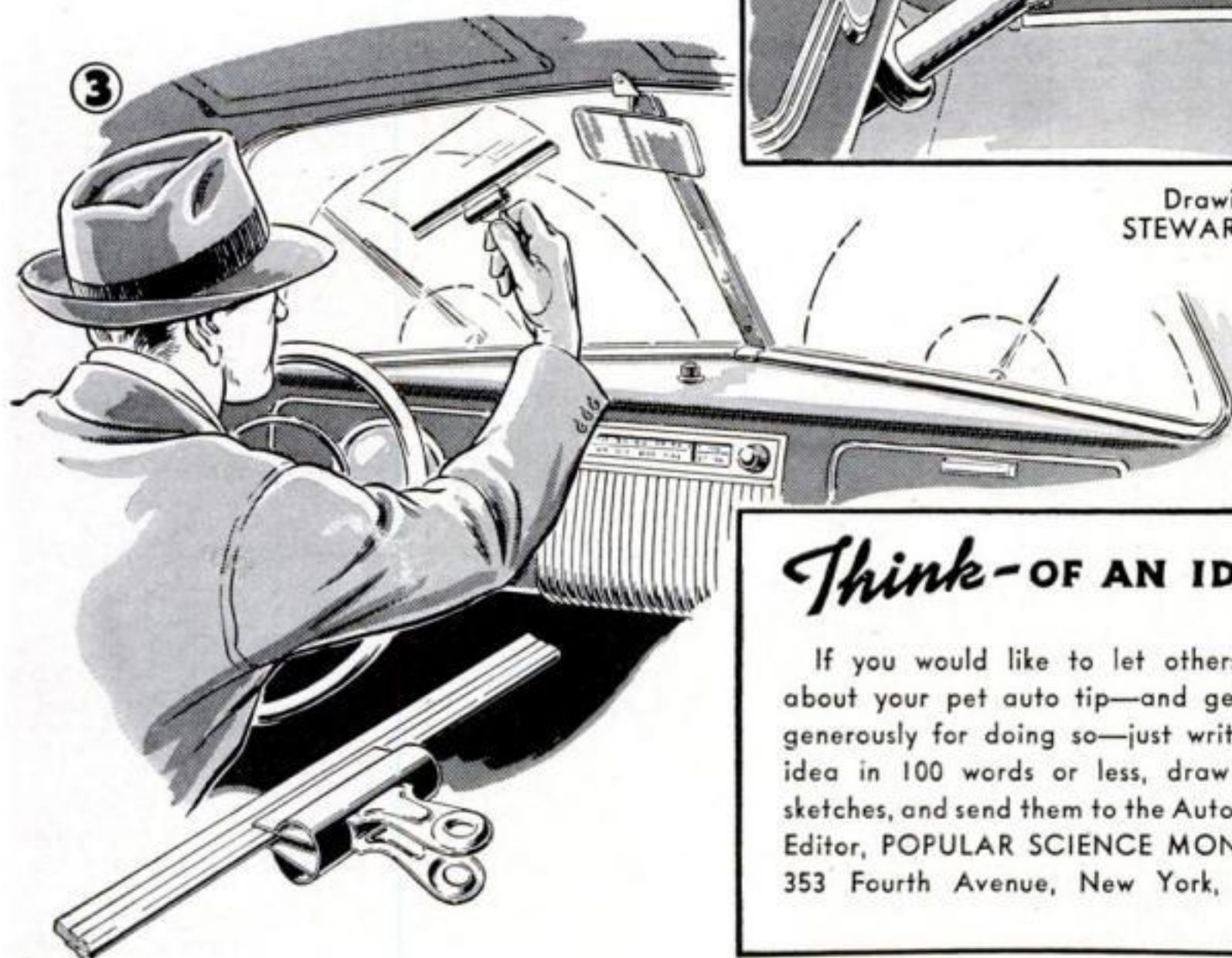
1 BOTHERSOME GLARE from cowl ventilators, particularly when they are opened so as to pick up bright light from the sky, can be overcome by applying a nonreflecting shield to the ventilator surface. This may be a piece of window-shade material or other dull fabric, cut to size, and attached to the thoroughly cleaned surface with rubber cement. A flat oil paint may be applied to the material to make it waterproof.—W. E. B.



2 DEFROSTER FANS that have wire guards can be made more efficient by attaching a piece of cardboard to the guard as shown in the accompanying drawing. Either elastic bands or pieces of string can be used to hold the cardboard cylinder in place. The resulting tube sends a stronger blast of air to a more concentrated area of the windshield. Laundry cardboard which is fairly flexible forms the best stock.—S. R.



3 FOR WIPING AWAY MOISTURE that has condensed on your windshield or side windows and made visibility difficult, a handy squeegee can be improvised from an old windshield-wiper blade. To facilitate using the blade, a jumbo-type, spring paper clip may be attached to its back.—D. B. J.



Drawings by
STEWART ROUSE

Think-OF AN IDEA!

If you would like to let others know about your pet auto tip—and get paid generously for doing so—just write your idea in 100 words or less, draw rough sketches, and send them to the Automobile Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.



Gus got a file and worked at the points until they were bright—and his hands were almost numb!

GUS pulls some wires

Sometimes it costs less to spend more on your car. The bankers call it covering your investment, but in the Model Garage it's just common sense

By MARTIN BUNN

IT was just turning dark outside when Joe Clark came into the Model Garage shop and found his partner Gus Wilson sitting on the end of his workbench placidly smoking his pipe and contemplating a floor entirely clear of cars.

"If you haven't got anything to do," Joe said a little caustically, "I should think that you'd pick out a more comfortable seat to do it in. I don't see how the dickens you. . . ."

The telephone in the office interrupted. "There's the 'phone, Joe," Gus said. Joe hurried away. Gus continued to smoke placidly. After half a minute he heard Joe call him, and went into the office.

"Elmer Jones on the wire," his partner informed him. He says he's stalled four miles

out on the dirt road, and wants you to tell him what to do about it."

Elmer is a mild young man who clerks in the local chain store and who, in his off hours, enjoys wandering about the surrounding country in an old crate which seldom actually breaks down but which always has something or other the matter with it. His voice over the wire sounded deeply discouraged.

"I'm sure stuck this time!" it wailed. "Had to walk pretty near a mile to get to this phone, and it's colder than the dickens out here. I've never had anything as bad as this happen to me before. I don't know what I'm going. . . ."

"What's the matter with your car?" Gus cut in on his tale of woe.

"I dunno," Elmer groaned. "She just won't run, that's all. She began to misfire, and I stopped the motor to find out what was the matter. I couldn't find anything wrong, but when I tried to start her up she wouldn't even turn over. I've tried pretty near everything I know, and it's getting dark and awful cold!"

"Take it easy—take it easy," Gus said soothingly. "I'll come out. Just where are you now?" Elmer told him. "All right, I know the house," Gus said. "You stay there and keep warm. I'll pick you up."

The last of the daylight was fading and snow rode a blustery gale when Gus turned his old but immaculate roadster off the cement of the highway onto the icy ruts of a little-used country road. It was black dark before his headlights picked up the white farmhouse at the roadside from which Elmer had telephoned him.

Elmer, who had been waiting on the porch, hurried out and jumped into the roadster nervously. "I'm worried about my lights—I didn't turn 'em on," he fussed. "I pushed my car a little off the road, but some one might run into it."

"They might—but there isn't much chance that they will. There isn't much traffic on this old road," Gus reassured him. He drove on steadily, and in a few minutes they stopped alongside of Elmer's balky sedan.

Gus got into it and stepped on the starter. Nothing happened. "Feels to me as if your battery has gone dead," he said. "Well, the first thing is to get your job back to town—when we've done that it'll be easy enough to find out what's the matter with it. Get in. I'll give you a push. You slide her into gear after I get her rolling. That'll start your engine if it's true that the trouble is a dead battery."

Elmer got into his jallopy, and Gus maneuvered his roadster behind it and then edged it out onto the road. Then, starting slowly and evenly, he gave it a long push. But the engine stubbornly refused to take hold.

Gus swore under his breath—Elmer had been right about it being cold out here in the country. "Guess I should have brought the wrecker," he said. "But I didn't, so we'll have to do the best we can without it. Let's see, now." He got his flashlight, raised the hood, and started a quick inspection. "How long have these distributor points been in?" he demanded after a minute.

"Only a couple of weeks," Elmer told him. "They're almost new."

Gus grunted. "They're badly

Joe found him ripping wiring out of Elmer's car. "What the dickens are you doing?" he demanded. "Just a little wire pulling. We all have to do it now and then," Gus grinned back at him

burned and pitted," he said. "Probably that is why your car won't start when we push it." He got a file out of his car's tool case, and worked at the points until they were clean and bright—and until his hands were almost numb. "Well, let's see what another push will do," he said.

Again he pushed Elmer's car down the road. For perhaps 20 yards nothing happened. Then the engine started, sputtered noisily for a moment, and then ran smoothly. Elmer stuck his head out and looked back. "Keep going!" Gus yelled at him. "Don't let your engine stop, for Pete's sake!"

Around a curve down the road headlights gleamed whitely from an approaching car. Elmer switched on his lights in a hurry. Gus saw them flare up to abnormal brightness—and then go black. A moment later a car roared past, its driver yelling something at them. And with a dying sigh, Elmer's motor stopped again.

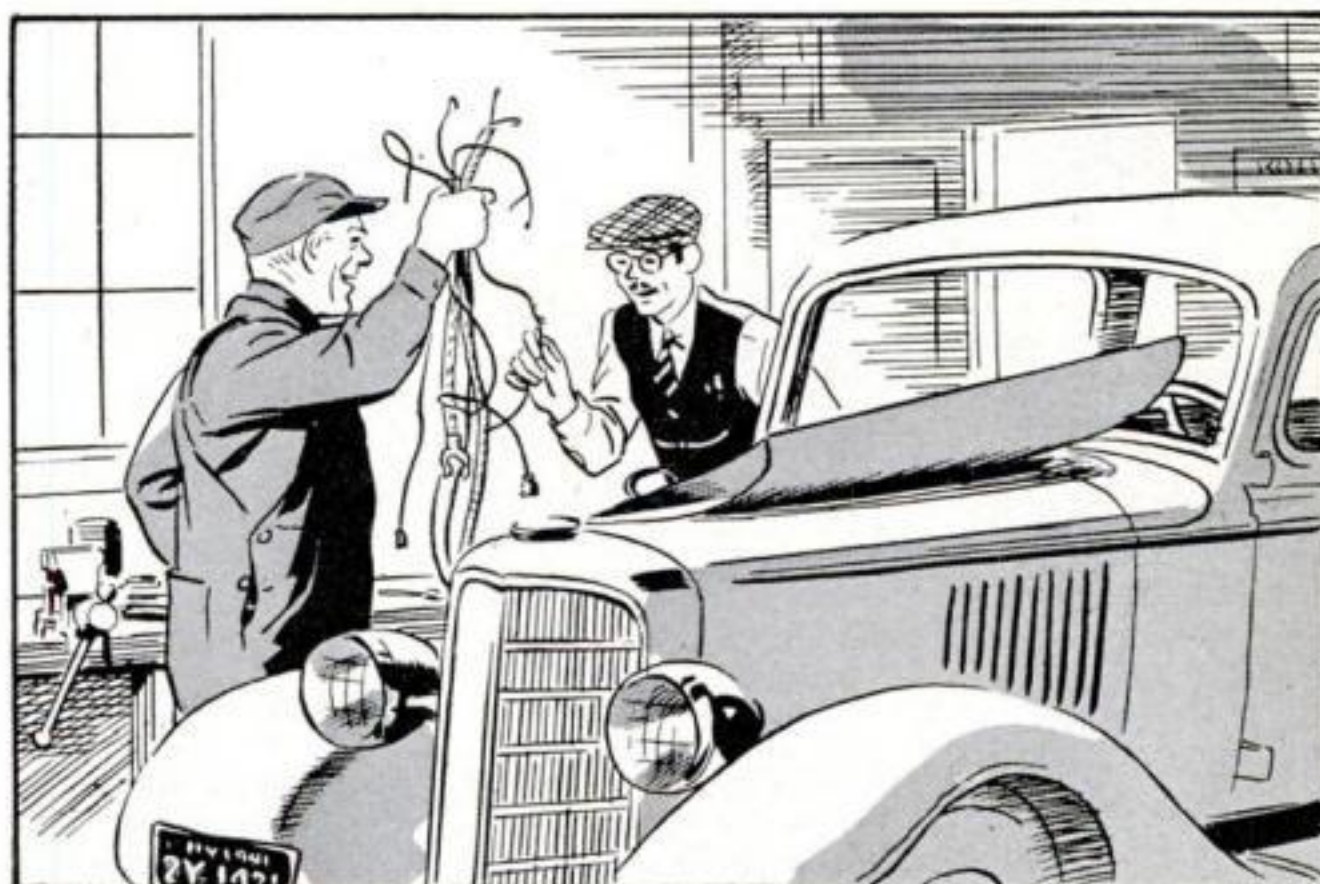
Gus got out and went up to the other car. Elmer seemed close to tears. "She missed a few times, and then went dead on me," he explained.

Gus looked at his watch. "No use fooling around any longer," he decided. "I haven't got a tow chain or rope with me, so I can't haul you in. I'll push you down to that farmhouse that you called me from, and phone Wally to come out with the wrecker and bring your car in."

"That's all right," Elmer said, "but how much is all that going to cost me? I've just paid for some work I had done on this darned bus, and I'm sorta broke."

"Don't worry too much about that," Gus told him. "I'll make the towing charge light—I should have come out in the wrecker in the first place. That's my mistake."

Gus telephoned to the garage for the



wrecker. Then they parked Elmer's car in the farmyard, and started for home. Gus dropped Elmer at his boarding house. "I'll look over your job in the morning," he said. "Right now I'm heading for the Park House and my dinner. When I've finished eating it, all I'm going to do is to find me a good hot radiator and sit on it until bedtime. Boy, am I cold!"

That night the mercury nose-dived to five below, and all next morning Gus was kept busy with frozen radiators and the numerous other motoring mishaps which always crowd repair shops the morning after an exceptionally cold night. As a result, he and his eager-to-learn but highly inexpert mechanic Wally weren't able to make a start on Elmer Jones's trouble-shooting job until after lunch hour.

Then Gus looked at the distributor points, and saw that they were as badly burned and pitted as they had been before he had cleaned them the afternoon before. He turned to Wally. "You get the floor boards up and test the battery," he told the grease monkey.

Ten minutes later Wally came over to his workbench with a hydrometer in his hand. "The battery's O.K., Boss," he reported importantly. "The hydrometer readings of all the cells are pretty near the same, and they're all over one point two fifty."

"Well, what does that prove?" Gus demanded.

"It proves the battery's charged," Wally said.

Gus nodded. "That's right," he agreed. "But if the battery is charged, why won't the starting motor start the engine?"

Wally scratched his beardless chin and shuffled his large feet. "I dunno," he admitted at last. "Why won't it?"

"I dunno either," Gus said. "Let's find out."

Just then Elmer came in, still looking badly worried.

"Hello," Gus greeted him. "Get yourself thawed out yet? I'm just getting started on your bus — had the shop full of hurry-up cold-weather jobs all morning."

He went over to Elmer's car and turned a flashlight on its exposed battery. Both its braided ground strap and its battery cable were covered with poisonous-looking green corrosion, and closer inspection showed that the bat-

tery cable was broken a couple of inches from the terminal.

"There's your trouble, Elmer," Gus said. "It's your own fault, too—you've been too careless to keep your battery connections bright and clean, the way they always should be, and acid that has spilled out of the battery has corroded both the ground strap and the cable—two of the most important links in a car's wiring system. The ground strap hasn't fallen apart, so far, but when you got on that rutted road yesterday afternoon the jarring snapped that corroded cable. That allowed the full voltage of the generator—which goes considerably higher than the voltage of the battery—to pass through your wiring system. Naturally, with the battery cable broken the starting motor couldn't start the engine, and when we got it started by me pushing your car with mine the excessive voltage from the generator both burned out your lamp bulbs and burned your distributor points so badly that the engine couldn't keep on running."

"Well, here's the bad news, Elmer—and it isn't nearly as bad as it might be. New points, a new battery cable, and new lamp bulbs will get your bus running again. I don't say that you will have a wiring system that I'd trust too far, but your car will run—for a while, anyhow."

Elmer's face got red. "To tell you the truth, Mr. Wilson, I had an engine overhaul job done at a shop down in the city—they gave me a low price, and they said that my wiring system was O.K. Could that be why the motor doesn't run as well as it did before they monkeyed with it?"

"More likely than not," Gus told him. "You're always likely to have ignition trouble after an engine overhaul if you leave the old wiring in. Putting new pistons, rings, and valves in an engine—you had all that done, didn't you?—always increases the compression. Well, that higher compression usually shows up ignition-system weaknesses that weren't noticed when the compression was lower."

Elmer did a job of serious thinking. "Well," he said at last, "I know that what you say about cars is always 100 percent right. Suppose you check over all my wiring, and phone me what should be done, and how much it will cost me? I've got to get back to the store."

"O.K.," Gus agreed. "I'll give you a (Continued on page 218)

GUS SAYS:

It's important to knock away those big chunks of dirty slush that form under your fenders in bad weather. If they freeze solid and fall off while you're driving out on the road, they can easily injure somebody or damage another car.

HOME AND WORKSHOP



IMPROVE YOUR HOME



NOW

HOUSE REPAIRS... PAGE 146
DAMP CELLARS... PAGE 162
PAINT PROGRAM... PAGE 164



GIVE YOUR HOUSE A NEW FACE

SUGGESTIONS ON REPAIRING AND RE-COVERING THE EXTERIOR WALLS OF FRAME BUILDINGS

By **CARL T. SIGMAN**
AND **WILLIAM J. WARD, JR.**

ON ANY program of home improvement it is natural and proper to begin with the outside walls. If you are planning to repaint, especially, it will pay you to examine the surface with great care to determine just what repairs should precede painting.

Weatherboards should last as long as the house, but parts of them do occasionally split. This may occur because unseasoned lumber was used, because of alternate wetting and drying, or as the result of improper nailing, which split the wood and allowed the entrance of moisture.

If the cracks are small, you need only chisel them a little wider and fill them with wood putty or a good caulking compound. Be sure the wood is perfectly dry when you do this. As a temporary expedient until permanent repairs can be made, you can cut strips of tar or building paper, or sheet metal, a little larger than the split areas, and push these strips up under the cracks.

Frequently damage is so extensive that entire sections of clapboards have to be replaced. To do this, gently drive a wide, thin chisel or a thin pry bar under the siding di-

rectly above the part to be removed. Insert two wooden wedges at the extremes of this section. With a try square, mark off the piece to be replaced. Reverse the handle on an adjustable keyhole saw and use this to cut out the damaged portion as shown in Fig. 1. Split away the lower part of the board as high up as you can; then slip a heavy hack-saw blade up under the remaining part to cut off the nails holding it.

Carefully cut a new piece the exact size of the one removed. Apply white lead or house paint on the joint edges and nail the board in place, using galvanized or other rustproof nails if possible. It is well to insert a piece of building paper or felt about 3" wide under each joint before nailing. Countersink the nails, give the new board a priming coat at once, and putty the nail holes after the paint is dry.

Often several boards, one above the other, must be replaced. In cutting these out, stagger the cuts so that they will not coincide (Fig. 1), as the joints should not come directly over one another. Start removing defective sections at the top, but work from the bottom up when inserting new pieces.

Corner boards frequently must be replaced also. These usually rot near the bottom rather than higher up, and may then let moisture get into the corner studding

or to the sill below. If no stains or cracks indoors give evidence of water damage, it may be necessary to cut out and replace only a small section of the corner post or studding.

Rotted sills are harder to replace. Remove the water table and cap to the length of the damaged portion, bracing the studding meanwhile with posts set on the basement floor under the joists. If the studding has settled into the rotted sill, the wall above must be jacked up before the sill is replaced.

Termites are a prolific source of trouble in some localities. As they are visible only when their shelter tubes or runways are broken open, the first sign of their presence may be damaged wood. Even this may be unsuspected, for badly infested lumber appears perfectly sound, but can be detected by testing it with an ice pick or pocket-knife. If you find soft spots that appear to be due to something worse than ordinary rot, consult a reliable termite control company at once. It will be necessary to replace all infested members with wood treated with creosote or chemicals. The soil adjacent to foundation walls and under flooring, steps, terraces and porches must also be treated to destroy termite colonies. Uninfected timbers that are susceptible to termite attack should be impregnated under pressure. The problem of termites is one that the home owner can hardly cope with himself. You will probably save money by seeking the help of reliable specialists at the first sign of trouble.

Side-wall shingles not of the best quality often warp, curl, or split. Such faulty ones should be nailed back before repainting is begun. If the curl is such the nailing may split the piece, drill holes for the nails and drive these home gradually to draw the shingle back into place.

Where shingles must be replaced, they can be removed by splitting them with a chisel or hatchet. Pull out, bend down, or flatten old nails. If several shingles must be removed, begin with the uppermost. In placing new ones you will, of course, start

from the bottom. Use only rustproof nails.

For stained walls, prestained shingles are preferable to those dipped on the job, as they are more thoroughly impregnated. On painted walls, give the new shingles a priming coat immediately after the repair is completed.

Caulk all cracks around doors and windows, and any joints between clapboards that have opened because of shrinkage of the wood. Good caulking is elastic and will expand and contract with the lumber. Small cracks can be filled from special applicator tubes. For filling large cracks, a caulking gun is needed. Caulking can be had in white, cream, gray, and in a few colors.

As metal is becoming scarcer, any urgent repairs on flashing should be made at once. Although copper is ideal, galvanized iron can also be used. It should be painted on both sides before installation.

Lead weighing from 2½ to 3 lb. per square foot is often used for flashing with good results. This material soon acquires a coating of white lead or basic lead carbonate that preserves it. If metal cannot be had in your locality, you can temporarily use a heavy building felt or roll roofing in the same way that metal flashing is used (Fig. 2).

Ventilation of attics, spaces under porch roofs, and similar inclosed places is a factor often overlooked in house construction. Just before you apply new siding may be the time to install windows, louvers, or screened ceiling vents. (Continued)

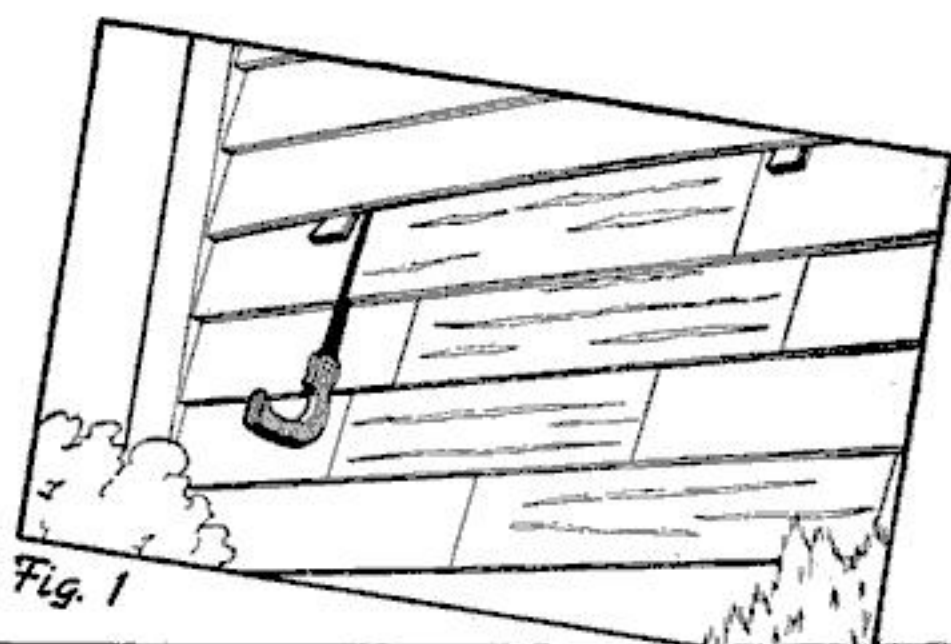
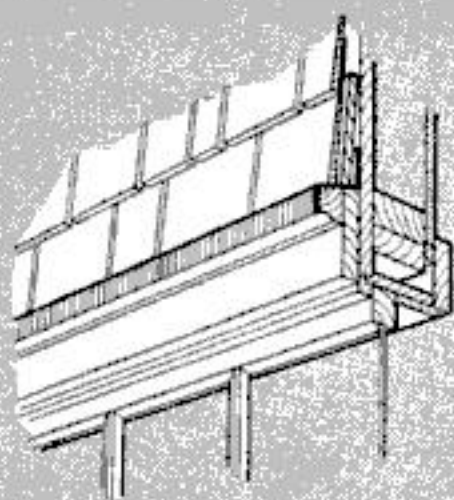


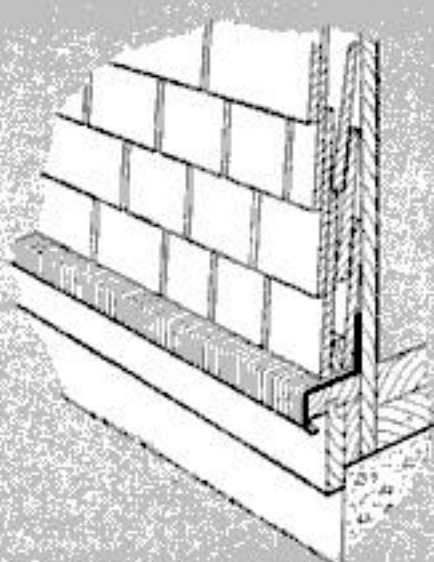
Fig. 1

Fig. 2

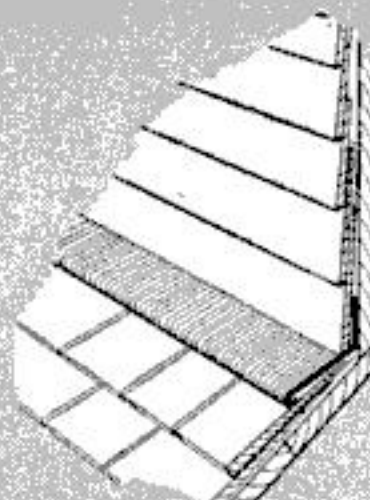
PROPER USE OF METAL FLASHING IN WALLS OF FRAME HOUSES



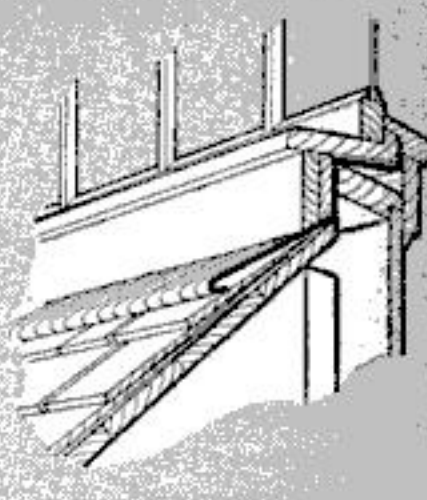
OVER WINDOW HEAD



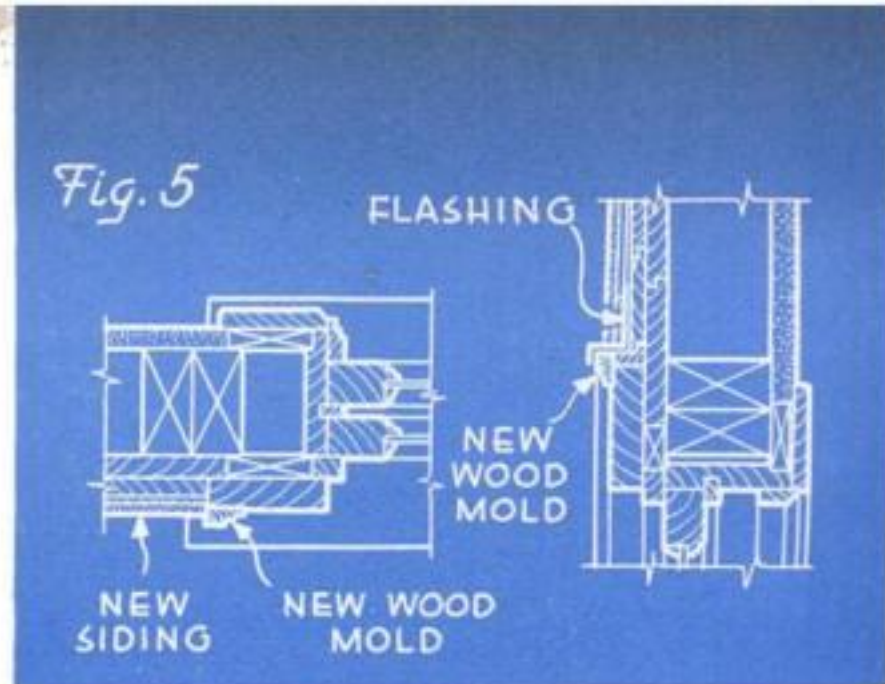
AT WATER TABLE



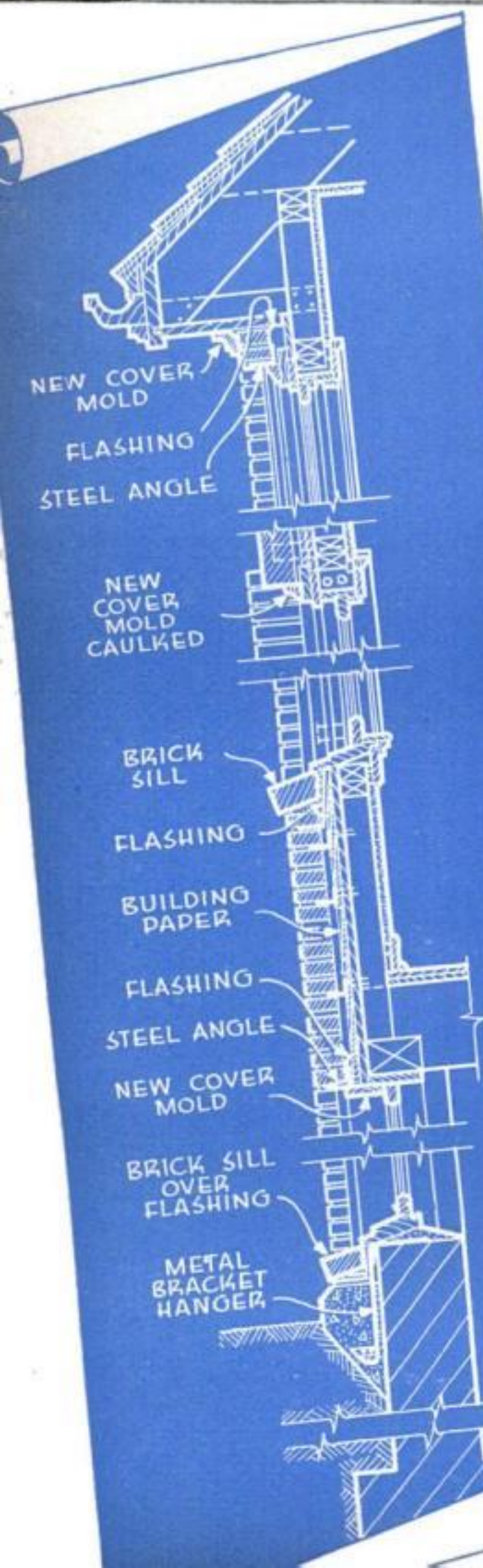
AT SHINGLE ROOF



UNDER DORMER



Where new siding or shingles extend beyond window frames, new molding and flashing must be installed, as shown in the horizontal and vertical cross sections



New clapboards or shingles of wood, asbestos cement, or asphalt composition can be nailed right over existing walls. Brick or stone veneers also can be applied, but both require new footings as shown in Fig. 4. Whatever is used, the additional wall thickness will result in keeping the house warmer in winter and cooler in summer.

Wood shingles are usually made from red or white cedar, cypress, redwood, or southern pine. They are available in two or three grades of each kind, and in 16", 18", and 24" lengths.

Greater exposure to the weather is permissible for shingles used on side walls than for those on roofs. Maximum exposure, that is, the length of that part of the shingles not overlapped by the following course, is as follows:

16"	shingles	—7½"	to the weather
18"	"	—8½"	" " "
24"	"	—11½"	" " "

Shingles can be nailed directly to old siding or shingles, but the walls should first be leveled by nailing wood lath or other filler strips, as shown in Fig. 3, below the butt ends of the old siding so as to take the shingle nails. A good-quality waterproof building paper or felt should be nailed horizontally over these before the new shingles are put on. Apply the paper with a horizontal lap of about 2" and a vertical lap of about 6" at the ends and corners.

Sixpenny hot-dipped galvanized iron nails should be used. Drive them flush, but not far enough to crush

the wood underneath. For securing waterproof paper or felt, use 1" long barbed galvanized nails with ⅝" heads. Disks or caps used under these should be flat and less than 1¼" in diameter.

Figure 6 shows five different methods of nailing random-width, dimension, and wavy-butt shingles. These last-named shingles are formed by band-sawing the shingles while they are still bound together in bundles as shown.

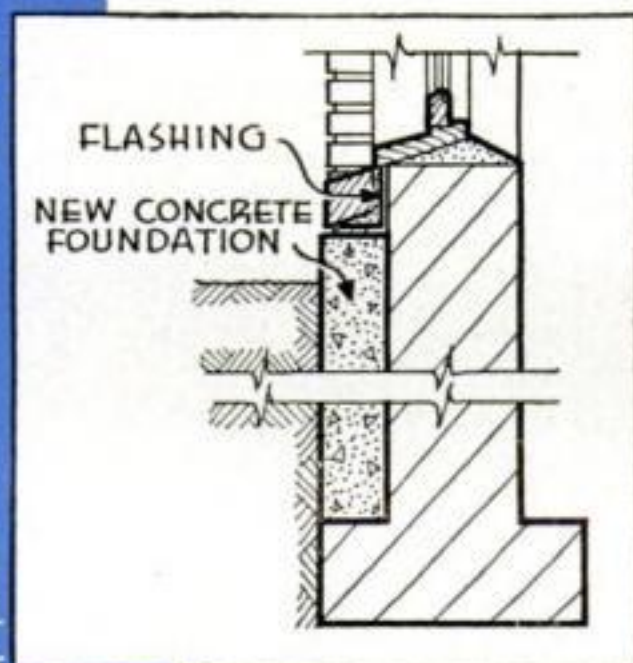
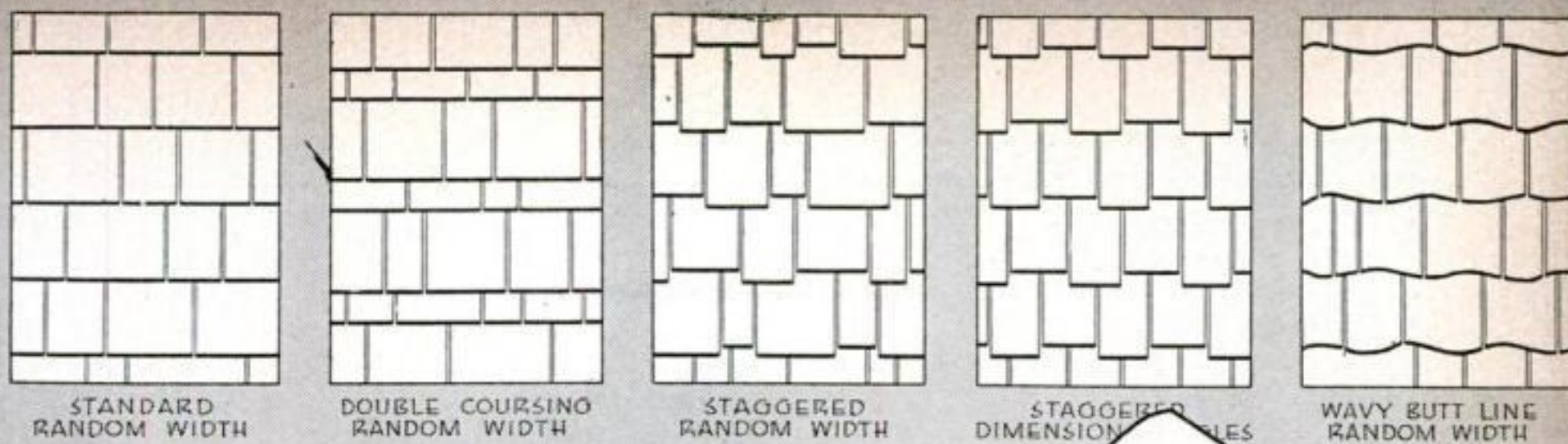


Fig. 4



In deciding what exposure to use, line up the butt edge with the upper or lower window lines, or both if possible. This is not only for the sake of appearance, but also to avoid unnecessary cutting. Shingles should be nailed along horizontal chalk lines snapped on at heights determined by the exposure. A better method where straight shadow lines are necessary is to tack a temporary strip to the wall and butt the shingles against this.

Double coursing (Fig. 7) provides additional insulation and a deeper shadow line, and with it considerably greater exposures are possible, as may be seen from the drawing. Second- or third-grade shingles can be used for the under course; in fact, it would be an extravagance to use first-grade ones. Face nailing with sixpenny, small-headed, hot-dipped galvanized iron nails is the rule.

In double coursing, the outer shingle has to extend $\frac{1}{2}$ " below the inner one to provide a drip projection. The rabbeted guide shown in Fig. 7 will insure a uniform overhang and a true butt line.

In providing a new surface over your old house, particularly when double coursing is used, you may find it projects beyond existing window trim, in which case new moldings must be applied and flashed, as illustrated in Fig. 5.

A comparatively new siding material is outdoor plywood, with which many novel architectural effects can be obtained. Its application cost is low because it comes in pieces as large as 8' long and 23" wide.

Plywood is available with either plain or rabbeted edges (Fig. 8) and can be laid with flush joints *A* or overlapped joints *B* like clapboards. Battens can be used over the rabbeted flush joints to provide additional waterproofing and afford certain architectural effects. Plywood siding is available in Douglas fir or redwood, and is double-rabbeted on the sides and ends. Sixpenny waterproof nails should be used as indicated in Fig. 8.

Ordinary siding, most of which is made from pine, redwood, or cedar, can be purchased in many shapes and sizes to give you almost any effect you could desire. Some standard shapes are shown in Fig. 9.

Fig. 6

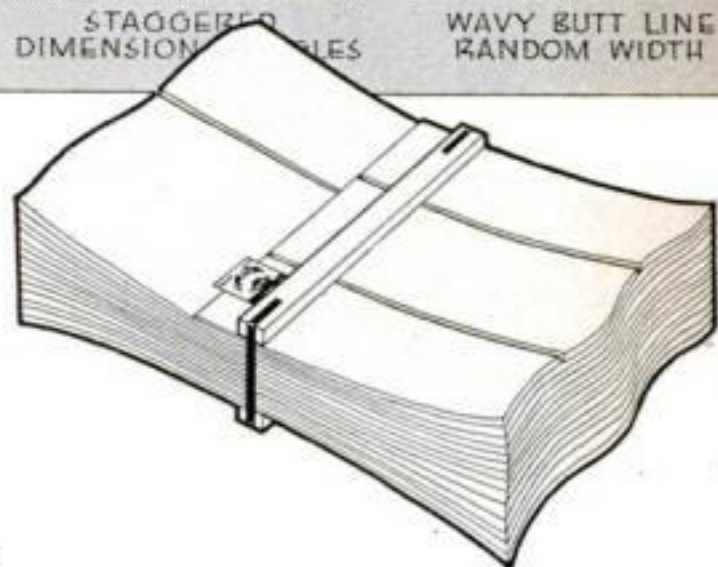
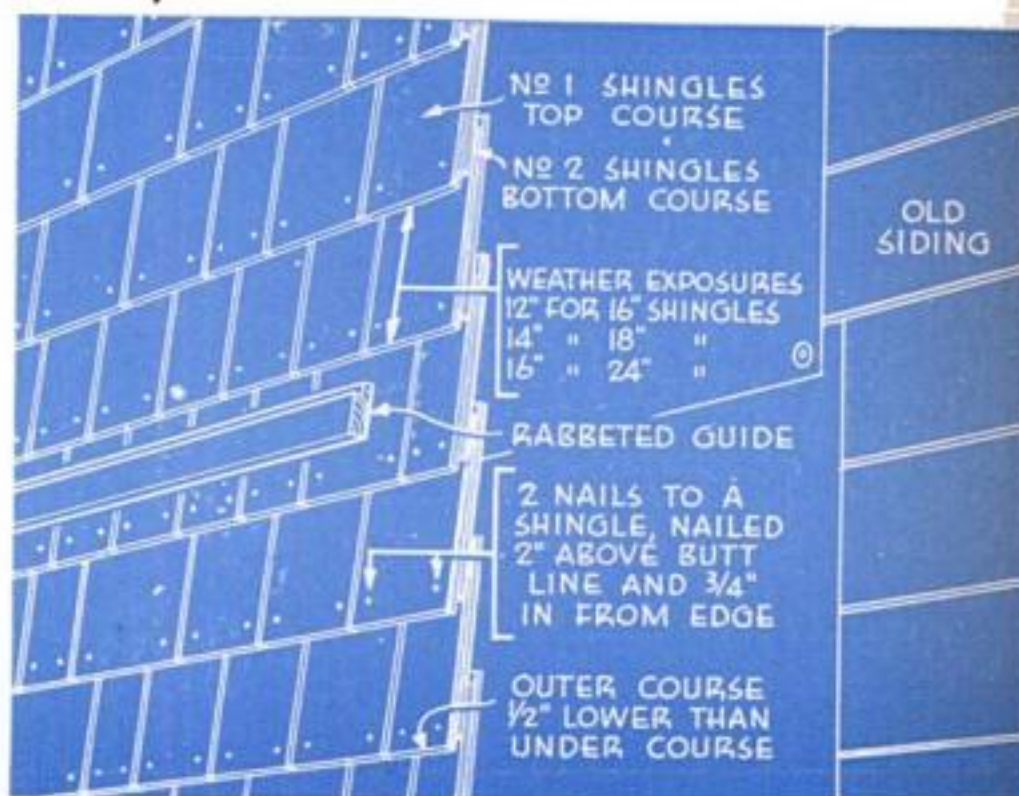


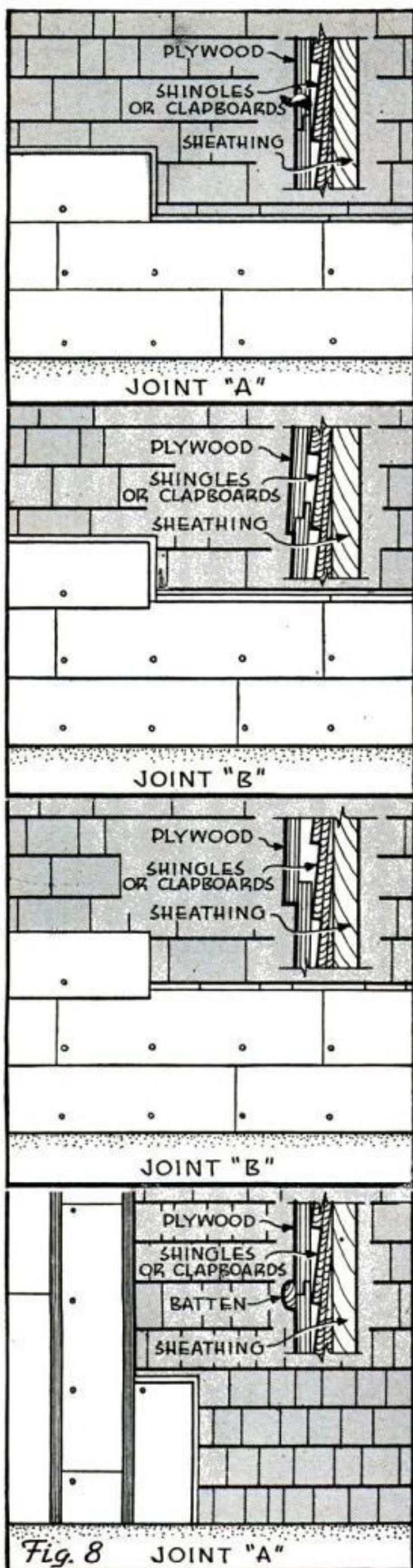
Fig. 7



They can be applied over old siding and shingles by first leveling up the walls with lath.

Composition shingles made of Portland cement and asbestos fibers under hydraulic pressure never require paint, and the newer glazed-surface types can be washed with soap and water like a porcelain dish. These shingles are available in white, silver gray, and several colors, and with two surfaces—smooth and cypress grained. You can also choose from several standard butt lines—straight, wavy, or irregular. The same material is also made to resemble brick veneer in tones of red and buff. All asbestos siding is, of course, fireproof and termiteproof.

Installation costs are low because shingles are available in widths up to 27". Nail holes are already punched and alloy-steel rust-proof nails as well as asphalt-felt joint strips are furnished with the shingles. All edges are die cut, and therefore form tight,



true joints. Asbestos-cement siding 8' long and 8" wide is also available.

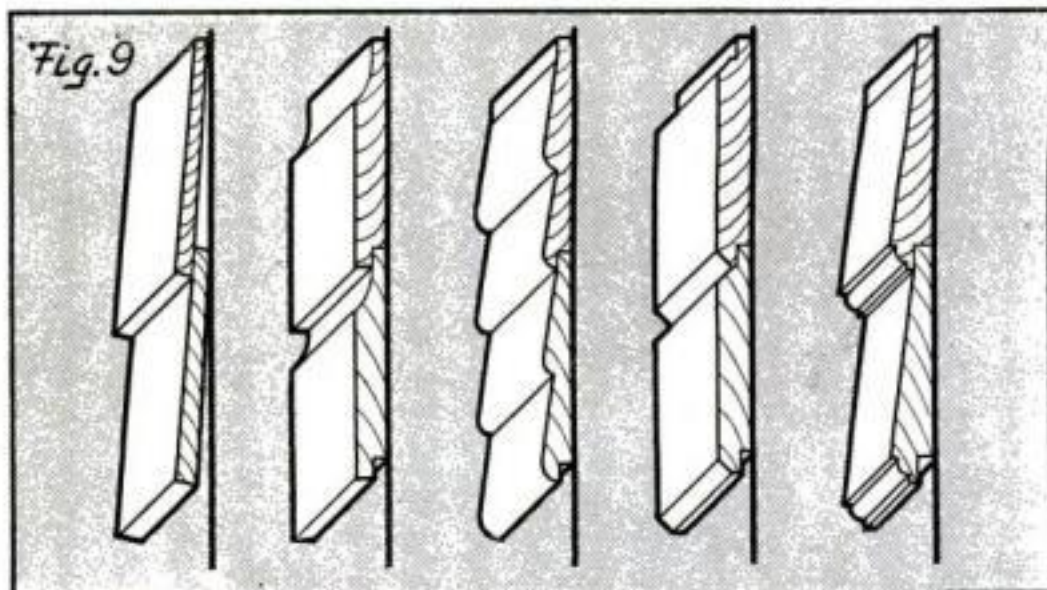
The Home and Workshop "cover" (page 145) shows workmen applying asbestos shingles over old siding. In this painting we have, of course, taken certain artistic liberties because we have endeavored to show all stages of the work and at the same time give a clear idea of the finished job in a single picture.

Figure 10 illustrates the correct application of asbestos shingles. The wall is leveled by nailing lath or tapered wood strips below the butt ends of the old clapboards or shingles, where the top nails are to be driven in. The drawing also shows three outside corners—one with corner boards, the second with a preformed metal corner bead, and the third with the shingles butted together directly.

After covering the whole wall area with waterproof building paper or felt properly overlapped as described, a $\frac{1}{4}$ " by 1" strip, known as a "cant strip," should be nailed to a level chalk line along the bottom of the wall. Some manufacturers recommend the use of heavy asphalt-felt or metal flashing at all corners over the building paper or felt underlay. Snap a level chalk line at a height of $\frac{1}{4}$ " less than the length of shingles to be used. The first course must extend $\frac{1}{4}$ " below the cant strip for drip projections. The second course should begin with a half shingle, which can readily be cut by scoring the surface with a sharp instrument such as a chisel and snapping the shingle over a straightedge. Fold a joint strip around the corner and apply the half shingle with two nails at the top and two at the bottom.

The second and succeeding courses can be aligned for proper exposure by inserting two nails in the holes at the butt of the shingle and allowing these to rest on the top edge of the underlying shingle. Drive nails up snugly, but not into the shingle itself. Under windows, where the top edges of shingles would be exposed, use alloy-steel nails or cover the edge with molding, because rust streaks will stain asbestos shingles. Copper gutters, leaders, and screens also may stain these shingles, so such metal should be coated periodically with thin spar varnish.

Be careful to store asbestos shingles in a dry place to prevent efflorescence or "blooming." If stored outdoors, they must be stacked on edge



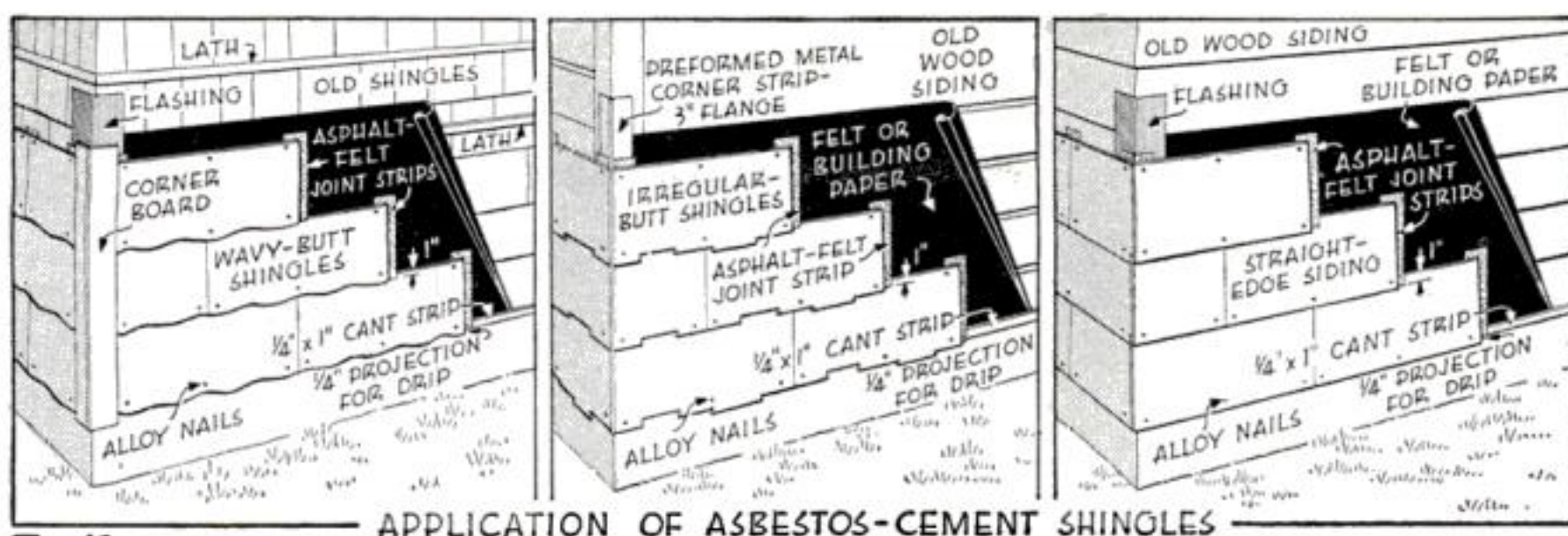


Fig. 10

APPLICATION OF ASBESTOS-CEMENT SHINGLES

at least 4" off the ground and not more than 3' high, and covered with some waterproof material.

A very popular type of shingle is that made from asphalt and felt, and covered with a mineral coating. Many of these have tapered butts. They are lower in price than asbestos shingles, and afford a wider choice of colors. Made in all the standard forms, they are fire resistant and termiteproof. Although used mainly on roofs, they look well on side walls. Like asbestos siding, they never require painting.

Another popular mineral-asphalt product is imitation brick finish, available in the form of insulated siding $\frac{1}{2}$ " thick (Fig. 11) and in rolls as illustrated in Fig. 12.

In using the siding over clapboards or shingles, the walls must be leveled up with lath as previously described, but no felt or building paper is required. This brick siding comes in five standard units. Chief among these are the master unit, for use on the main part of the house, and the soldier-course panel, which is used as the starting course at the bottom (Fig. 11). Both of these have extended tongues at the top and right side and recesses at the left side and bottom to receive the tongues of adjacent pieces. There is besides a single-course strip to fill out eaves, window sills, and the like; a trim unit resembling a header course for use around windows and doors; and a corner piece. All of these are shown in Fig. 11.

Such brick siding must be nailed with 2" rosin-coated or rustproof nails in the joints only, as indicated by black spots in the drawing. As the material is applied, all joints should be sealed with a specially prepared caulking compound.

Apply the soldier course first, but do not let it come in contact with the ground. Above this, nail on a master panel from one side of which a piece $1\frac{1}{2}$ bricks wide has been cut off. Continue with full-sized panels in that course. To start the third course, cut two full bricks from a master panel and nail this piece in place. Again follow with full-sized panels in this course. Start the fourth course with a panel trimmed $3\frac{1}{2}$ bricks on one side. The fifth course is then begun with a full-sized panel, and the order of courses repeated as before. Trim strips around doors and windows, and corner pieces, are nailed in place last.

Somewhat cheaper is the imitation brick finish that comes in rolls, as shown in Fig. 12. Since this type is flexible, a rigid underlay of waterproof sheathing board has to be nailed over old siding or shingles. Where one roll meets another, a 4" wide piece of metal flashing is placed beneath the joint.

Still a third type of brick-finish siding comes in strips one brick high. This has the advantage of requiring no rigid under-surface, but old siding with exposures of more than 3" must be leveled up with lath or stripping as for shingles (Fig. 13).

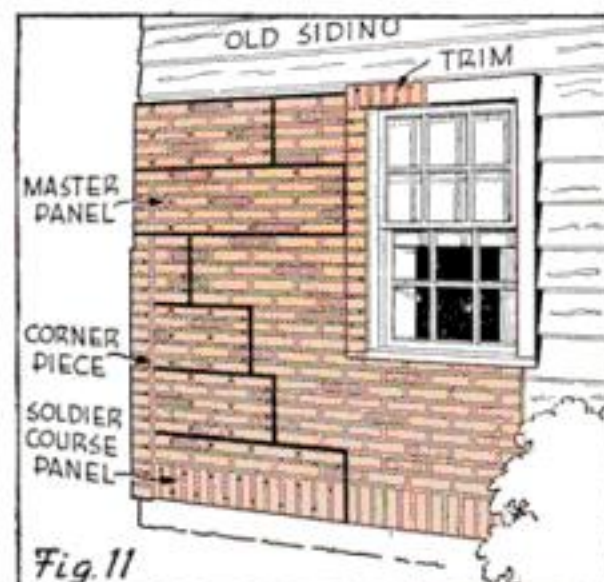


Fig. 11

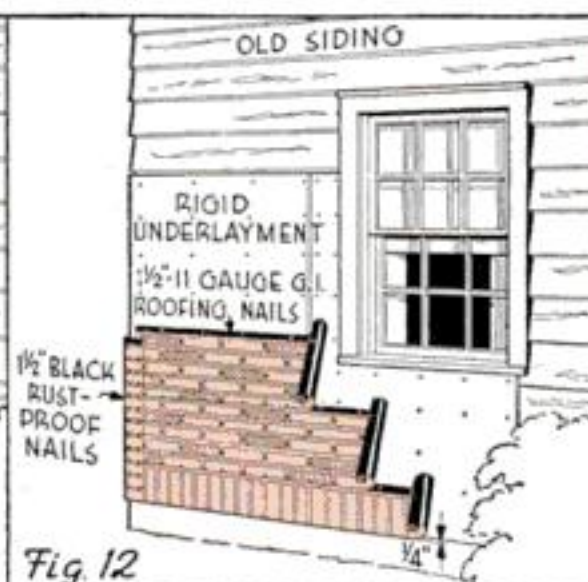


Fig. 12

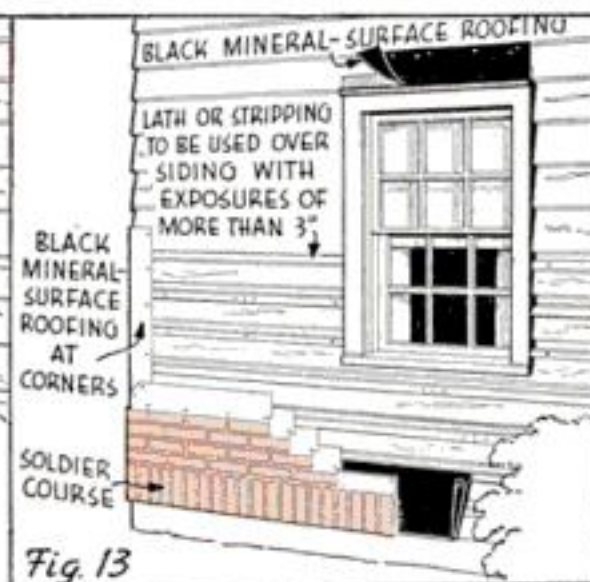


Fig. 13

IDEAS for HOME OWNERS

GLASS NAILED TO THE WALL modernizes bathrooms and kitchens. It is done with a new prefabricated type of structural glass cemented to plaster board in such a way that a flange of the backing extends out from the edges. This flange is nailed directly to the studding. The plates can be used next to either a plain wall or plaster without the addition of molding, and installation can be done by a carpenter. The panels are practical above bathtubs, behind lavatories, and as sink splashboards in kitchens.

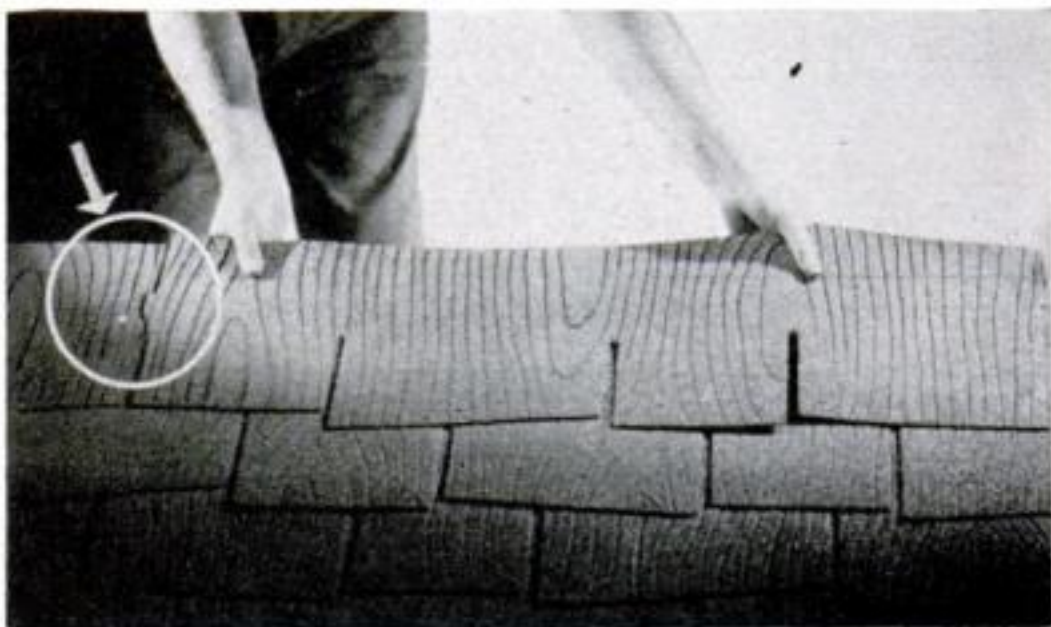


This new plastic caulking material looks like cord and can be pressed into place merely with the fingers

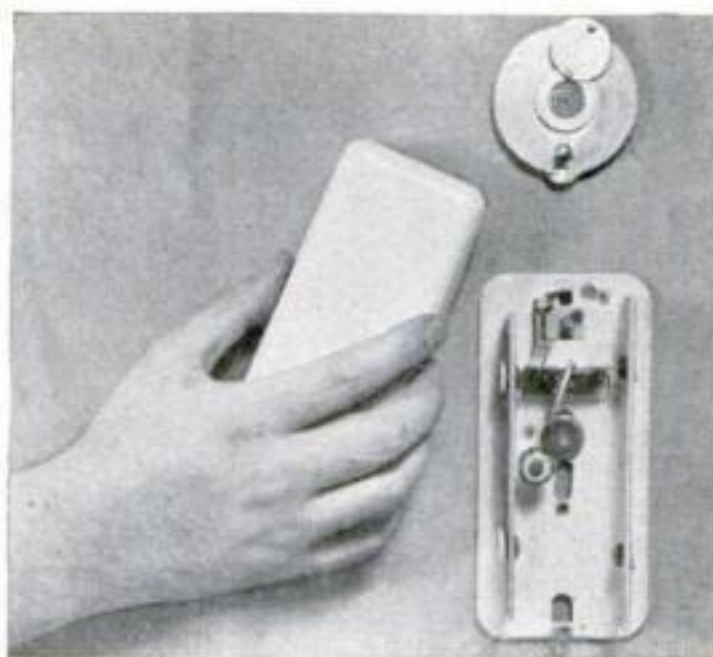


PLASTIC CAULKING MATERIAL is available in the form of rolls or beads for use on window and door frames, to seal cracks in wood and plaster, and for waterproofing the edges of tubs and other bathroom fixtures. Somewhat cordlike in appearance, it can be applied without tools simply by pressing it into the opening to be filled. The compound is non-oxidizing and, since it remains plastic while in use, will not crack with changes in temperature or the expansion and contraction of surrounding areas. It is grayish white in color, can be painted over almost immediately after installation, and will not stain painted surfaces it touches.

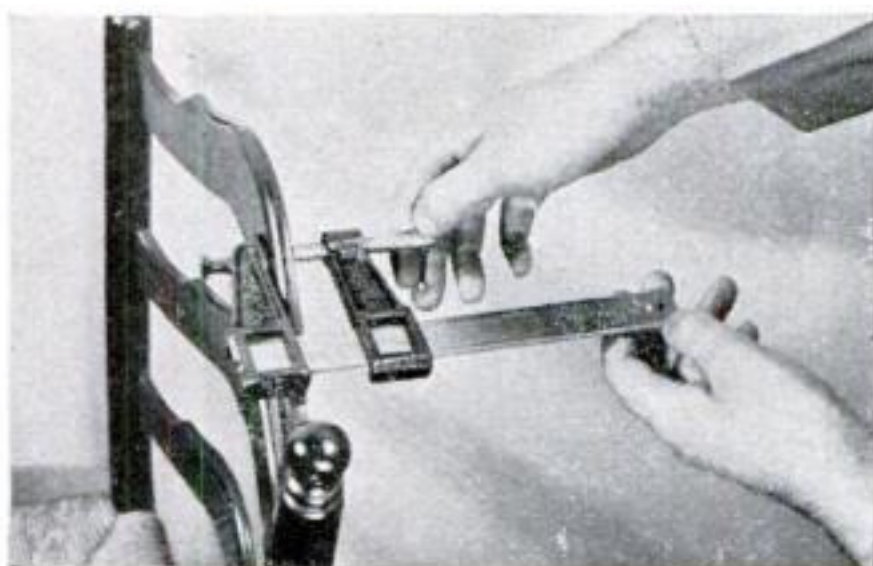
RANDOM SHINGLE EFFECTS are obtained now with the use of strip shingles, each strip having four tabs of irregular lines and widths. A system of notching assures proper alignment whether the shingles are put on from left to right or the reverse and regardless of the order. The notches also are so arranged that nails are covered and joints are protected. The strips come in four blended tones on simulated wood-grained textures that accentuate shadow lines.



DOOR KNOCKERS THAT SOUND CHIMES lend a musical note to the arrival of visitors. No electricity or wiring is required, mechanical chimes being mounted on the inside of the door panel where they are sounded by the lifting of the knocker. Two harmonious notes are struck, and can be adjusted to suit the ear of the householder. This is a feature of special advantage in those apartment houses where neighboring doors are close together, for the notes can be made to differ enough from the neighbors' to avoid confusion. Also available in a matching metal finish is a door lookout through which visitors can be identified before the door is opened but through which they themselves cannot see. The lookout can be closed with a hinged disk.

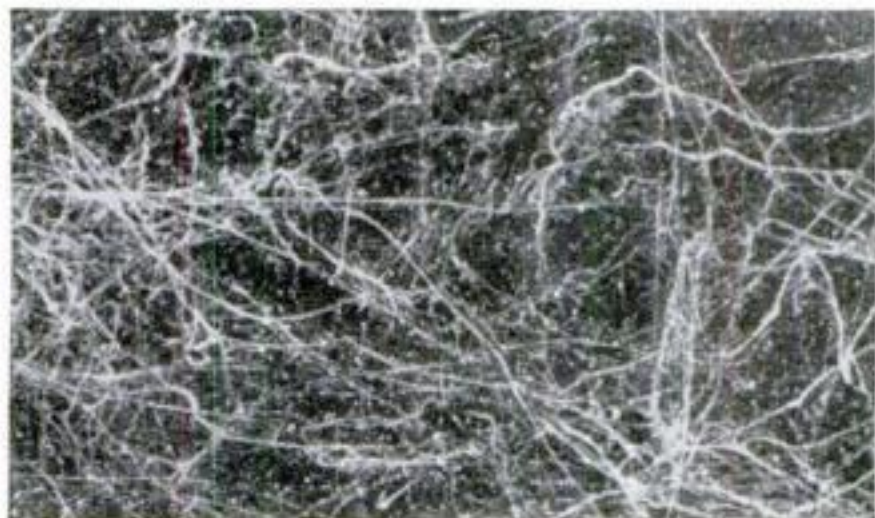


Mounted directly on the inside of the door panel, these chimes are sounded mechanically with the raising of the knocker. Callers can be identified through the lookout hole

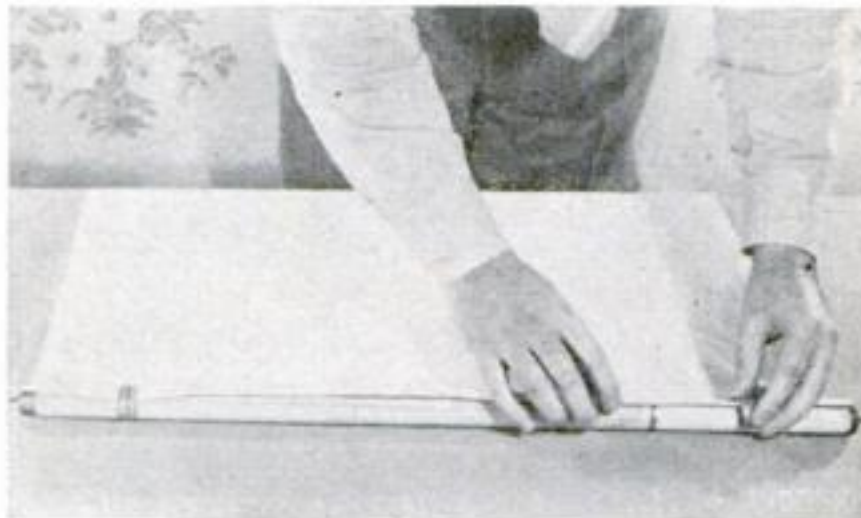


THIS INSTANTLY ADJUSTABLE CLAMP, handy for home furniture repair and other wood gluing jobs around the house, is set first on a notched bar to the approximate dimension of the work. Tightening up the adjusting screw presses the glued wood together and also holds the movable jaw firmly against the notched bar. The bar is of bright steel and the jaws of heavy cast metal finished in red enamel. Jaw edges are knurled for a sure grip. The clamps are available in two sizes, one with a maximum spread of 6" and the other 12".

MARBLE IN A CAN is a spraying paint that looks like enamel or lacquer, but "mists" out, when applied with a gun, into long, fine filaments that dry as they settle with an effect like the veins in marble. It comes in white, black, red, blue, yellow, aluminum, and gold, but can be intermixed to produce a variety of other shades. The finish can be used on metal, wood, plaster, composition board, pottery, and glass.



REVERSIBLE WINDOW SHADES, which have a double life, can be attached to the roller at either end. Once the shade becomes soiled, it can be switched around so that the clean upper section is at the bottom. Both edges are hemmed alike and are fastened to the roller by means of three easily removed snap-on copper clips. The shade itself is made of a tough fiberized paper which resists wrinkling and tearing.



KEEPING



Torn upholstery can be mended almost invisibly by the use of surgeon's adhesive tape from the first-aid kit. There will be no stitches to show. A piece somewhat longer than the tear must be inserted under the material, sticky side up. The two torn edges are pressed against this, together with any raveled threads. Be sure to align them so that no wrinkles will be formed



Like anything else, decorative candles in the home may become dusty in time. To clean them and restore the luster, wipe with a soft cloth that has been dampened slightly with alcohol



When cutting taffy or marshmallows for dessert recipes, you can prevent the candy from sticking to the scissors by slicing the blades from time to time across a bar of paraffin wax



To open a sealed envelope or remove clippings from scrapbooks without harm to the paper, work a sharp pencil between the pasted surfaces with a rolling motion

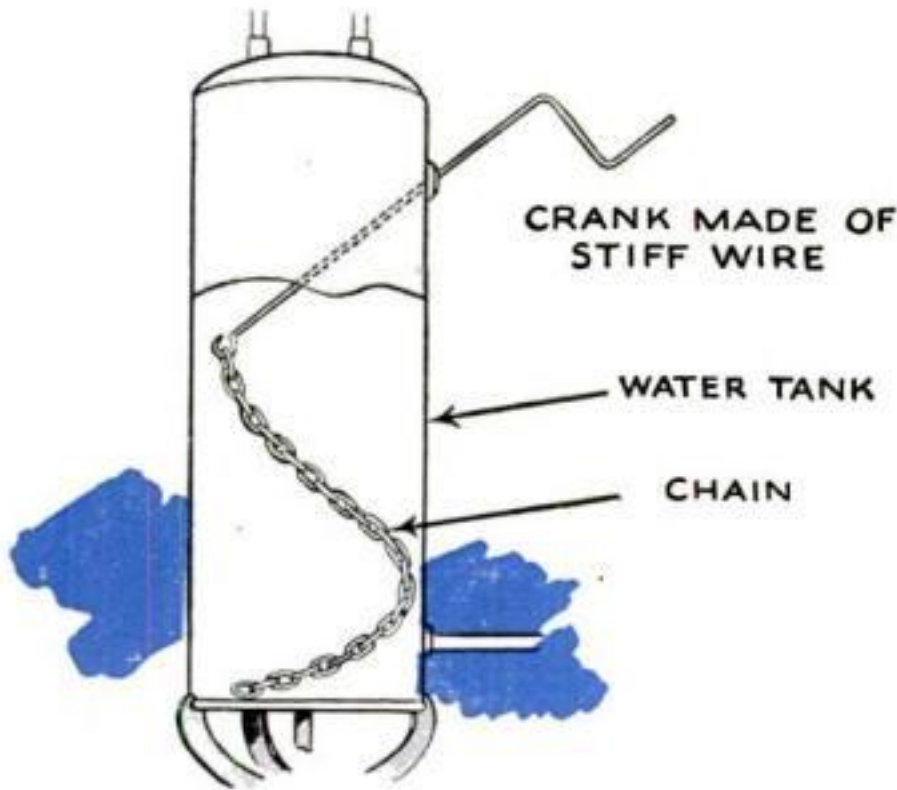


The bottom of a scouring-powder can will not leave rust marks on a tile drainboard or on bathroom shelves if its edge is covered with adhesive tape as shown above

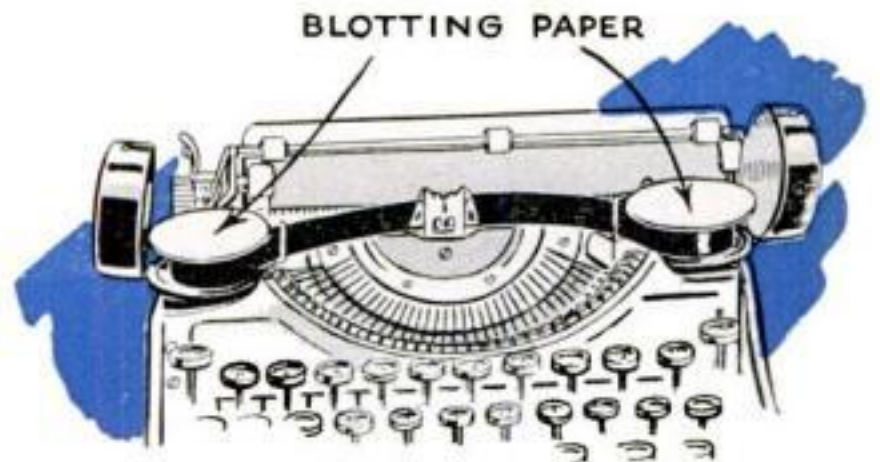


Filter papers for coffee making are always at hand when needed if taped to the top of a coffee can. Exchange lids whenever a new can is opened

THE HOME SHIPSHAPE



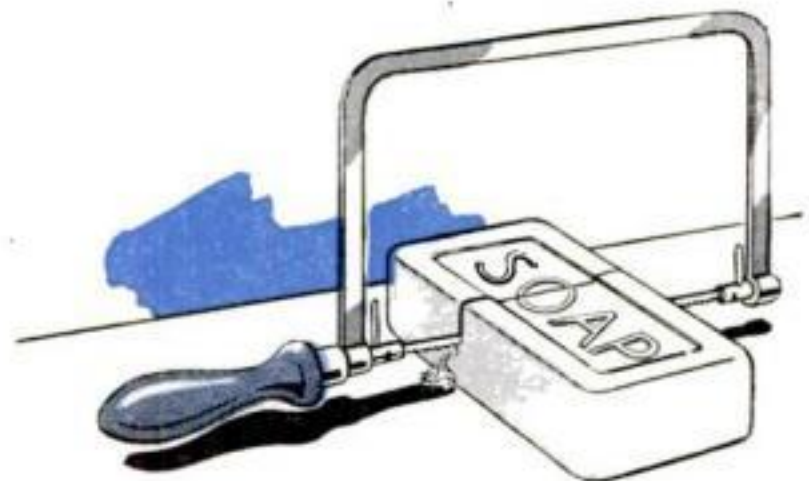
Rust and sediment in a hot-water tank can be dislodged by using a length of chain on a wire crank as illustrated above. Work the chain about vigorously while allowing dirt-laden water to drain off



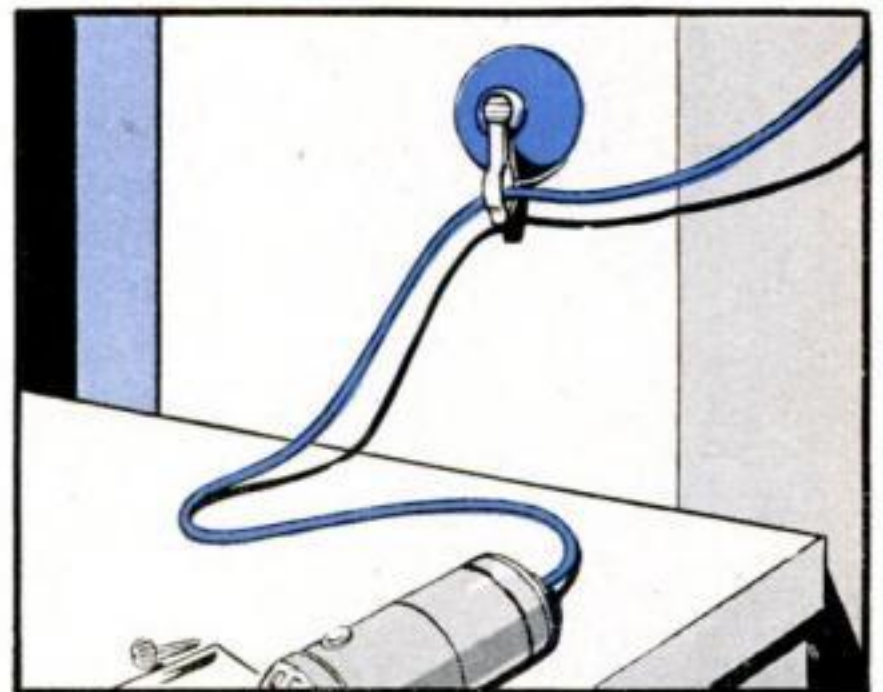
Most typewriter ribbons dry out before the ink in them is exhausted. In order to prevent this, place a disk of blotting paper soaked with light machine oil on top of each spool under the cover



This closet rack will hold a good many pairs of women's shoes. Bore holes for $\frac{3}{8}$ " dowel rungs in 1" by 2" furring strips. Drive a nail through each joint. Assemble the two "ladders" with cross dowels so that each rung is midway of those opposite



Cutting hard soap with a knife is not only difficult, but likely to be dangerous in case of a slip. Borrow a coping saw from the home workshop to do the job safely and with a minimum of waste



The type of rubber suction cup that has a clip attached is very convenient for fastening extension cords to a wall or holding them off the workbench and out of the way when one is using an electric hand grinder or any similar cord-connected device

A brilliant, beautiful wet fly, the Parmachene Belle. This is considerably larger than full size. The hook is known as a No. 6, long shank



Fly Tying Made Easy

THE FUNDAMENTALS OF A FASCINATING PASTIME THAT IS OPEN TO ALL ANGLERS

By Ray Bergman

Angling Editor of "Outdoor Life"

THE making of flies has become a national pastime, if not an industry. In every town and hamlet one will find devotees of the art. This article on the essentials of fly making is directed to the novice, but it may well help those who have been struggling with the job for some time.

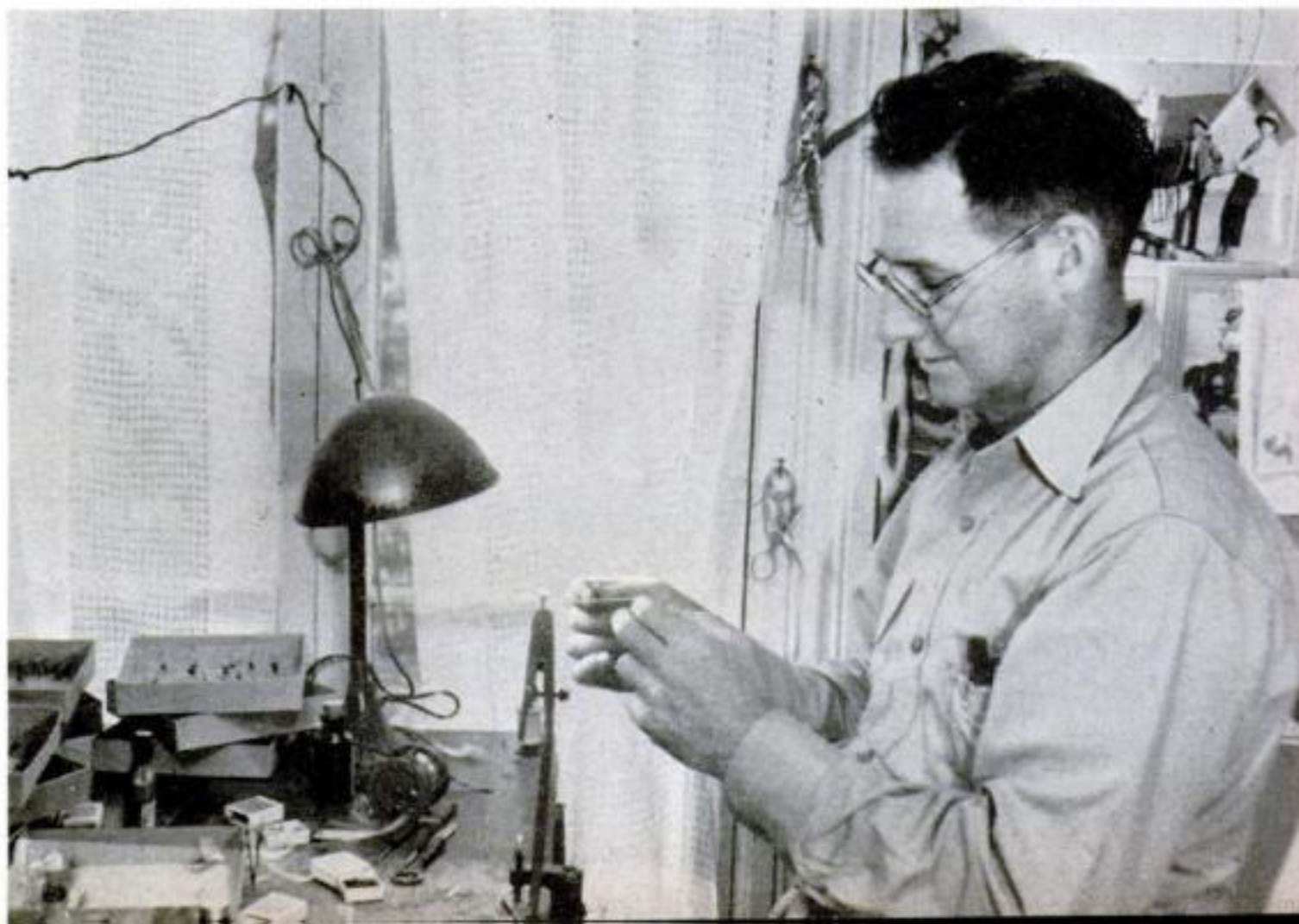
Tools. To begin with, you need some tools. In the lower illustration on page 158 three different fly vises are shown. *A* and *B* are best for regular work where you have a flat surface to clamp to. *C* is a special clamp-on vise for use anywhere, but because the jaw is not offset and a wing nut is used as a tightening device, it is not as efficient as *A* and *B*. *F* is a pair of hackle pliers. Unlike

ordinary pliers, the jaws open when you squeeze. This tool is used to hold the fine hackle feathers as they are wound on.

The scissors *D* may be either curved or straight. I suggest having both types. They should be of good quality because the stems of feathers and tinsel are both very hard on scissors, and a cheap pair is an abomination. Be sure the scissors will cut close to the points. Try them before buying.

The tool *E* is properly called a "dubbin needle" but is usually referred to as a stiletto in the United States. ("Dubbin" or "dubbing" is the body substance of a fly.) With the needle you can rectify mistakes in tying, finish off knots, and remove lacquer that may get into the eye of some flies. A stout sewing needle would serve as a substitute for this tool.

Ray Bergman at work tying a fly. He is one of the foremost authorities on fishing and the author of two of the best-known books on the subject, "Just Fishing" and "Trout." Note the type of fly vise he uses himself



At *G* are shown a few hooks used in fly tying: 1. Extra long streamer hook. 2. Heavy wire salmon fly hook; also very good for streamers which one wants to sink readily. 3. Light wire salmon dry-fly hook; also good for sparsely tied streamers or wet flies. 4. Medium-length streamer hook; also suitable for large dry flies, especially the May-fly type. 5. Ordinary wet-fly hook. 6-8. Dry-fly hooks of various kinds.

The only necessity not shown is the thread. For this get the regular fly-tying silk on sale at any fly-material shop or any tackle dealer handling fly-tying materials.

Unless you can tie the proper knots, you will not be able to do a good job. Only two knots are needed, and these will be described in detail. First, however, wax your thread. Unwaxed thread will not hold or grip the hook.

The Special Slip Knot. This is used for all in-between operations when the more substantial whip knot is unnecessary. Start the thread from the hook as shown in *A* in Fig. 1. Do this by winding the thread around the hook shank, and tie it the best

you can until you learn the right knot. With the end of the thread in the right hand, make a loop over the left forefinger, bringing the thread over the top of the hook as shown.

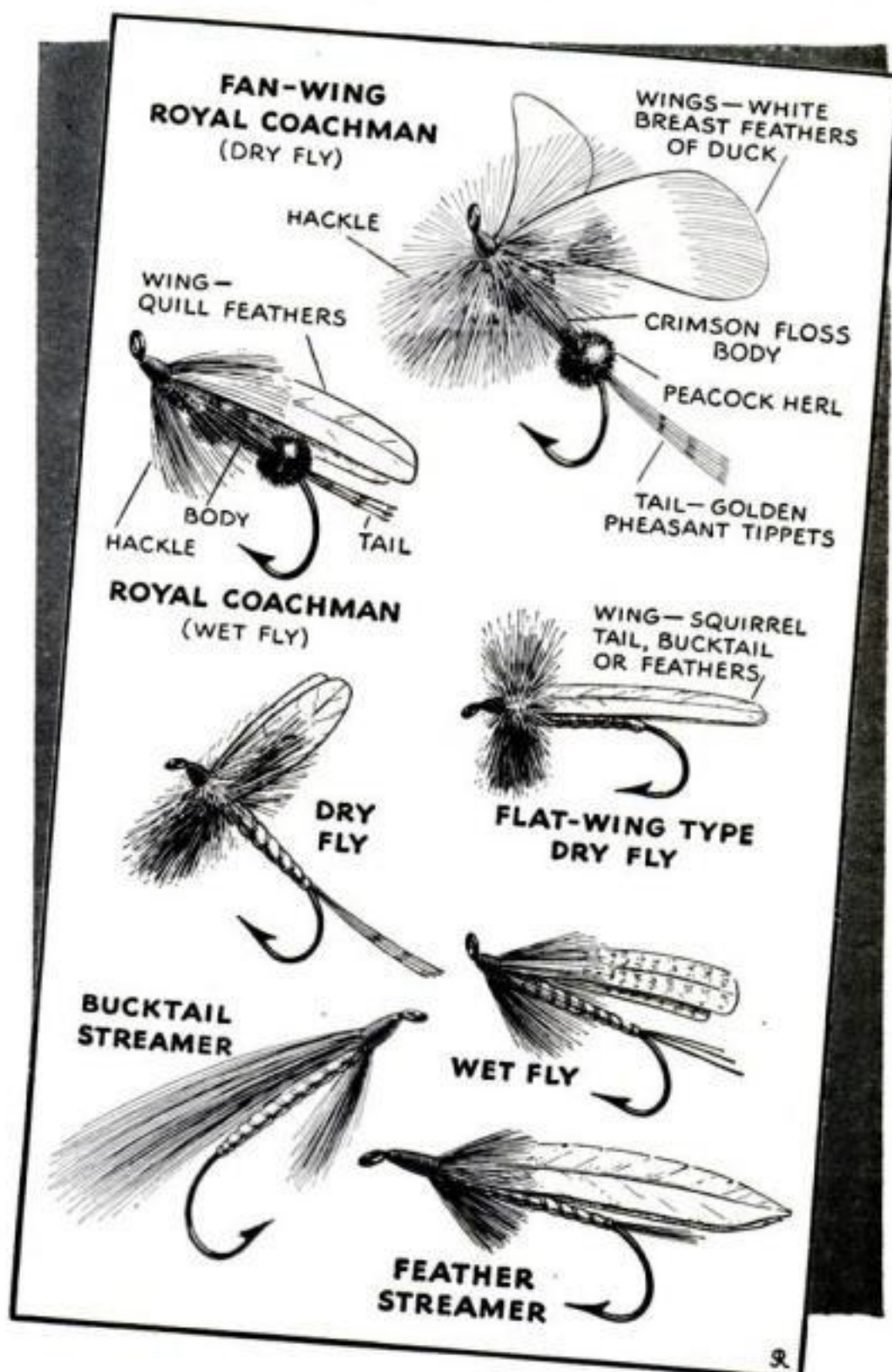
Bend the thread end around the hook and back as at *B*. With the second finger of the left hand, hold the loop; and with the first finger, pull the end held by the right hand through the loop. Be sure to keep a steady pressure with the right hand. The sketch marked *C* shows the end thread pulled through the loop with the first finger. Now keep pressure against the loop by the thread end held in the right hand and the loop held by the first finger of the left hand. Take away the second finger, and this will leave the loop held taut by the pressure at point *X* in sketch *D*. The loop is ready to pull to the hook shank. Pull thread *Z* so that it brings the "pressure junction" (*X*) to the hook. Then pull through the loose end shown held by the right thumb and fore-

Two typical flies, with their parts named, are shown below. The other sketches are representative of the main divisions of flies—dry, wet, bucktail streamer, and feather streamer

Fly-Tying Materials for the Beginner

Bucktail

- Brown hackle neck (cock)
- Barred-rock hackle neck (cock)
- Ginger hackle neck (cock)
- Scarlet or bright red hackles (dyed hen's or soft cock's)
- Peacock feathers
- Mandarin (half skin)
- Speckled mallard feathers
- White duck or goose quill feathers
- Slate duck or goose quill feathers
- Golden pheasant tippets
- Gold and silver tinsels, both wide and narrow
- Jungle cock eyes
- Chenille in yellow and black; other colors if desired
- Piece of blue-gray fur
- Piece of red fox fur
- Assorted yarns
- Floss silk, assorted colors, including yellow and bright red
- Enamel for streamer heads
- Varnish or lacquer for heads of other flies



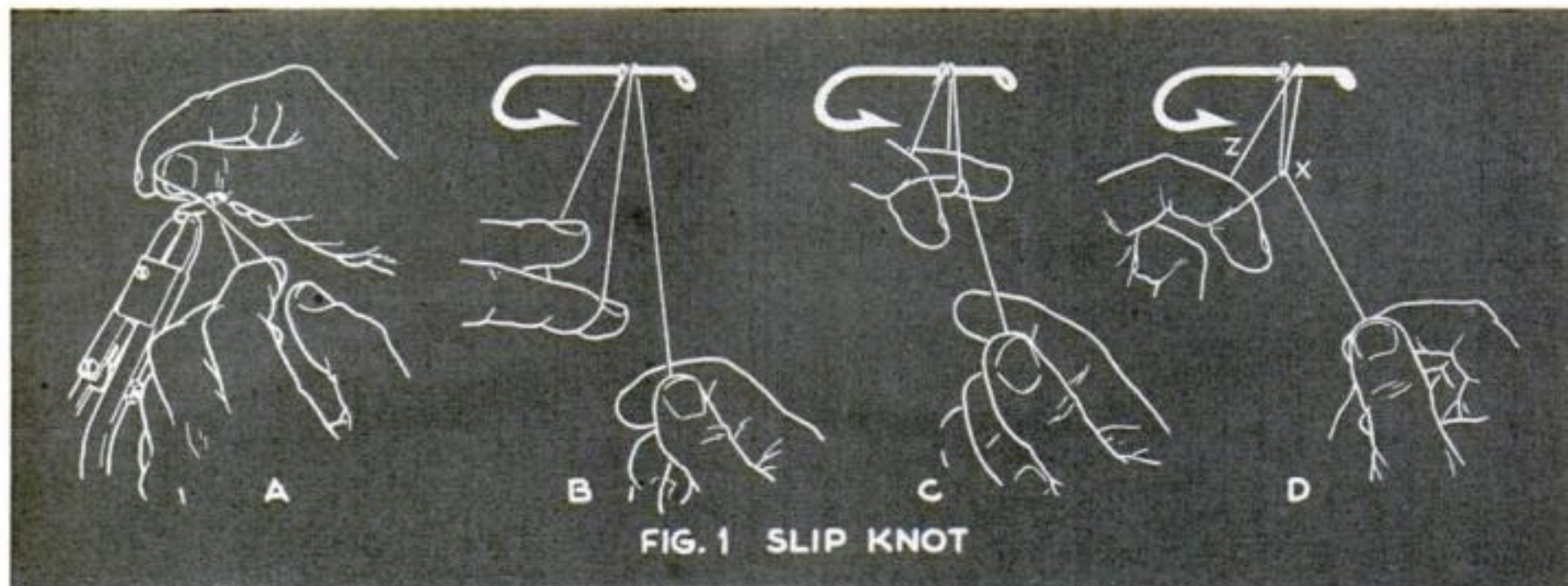
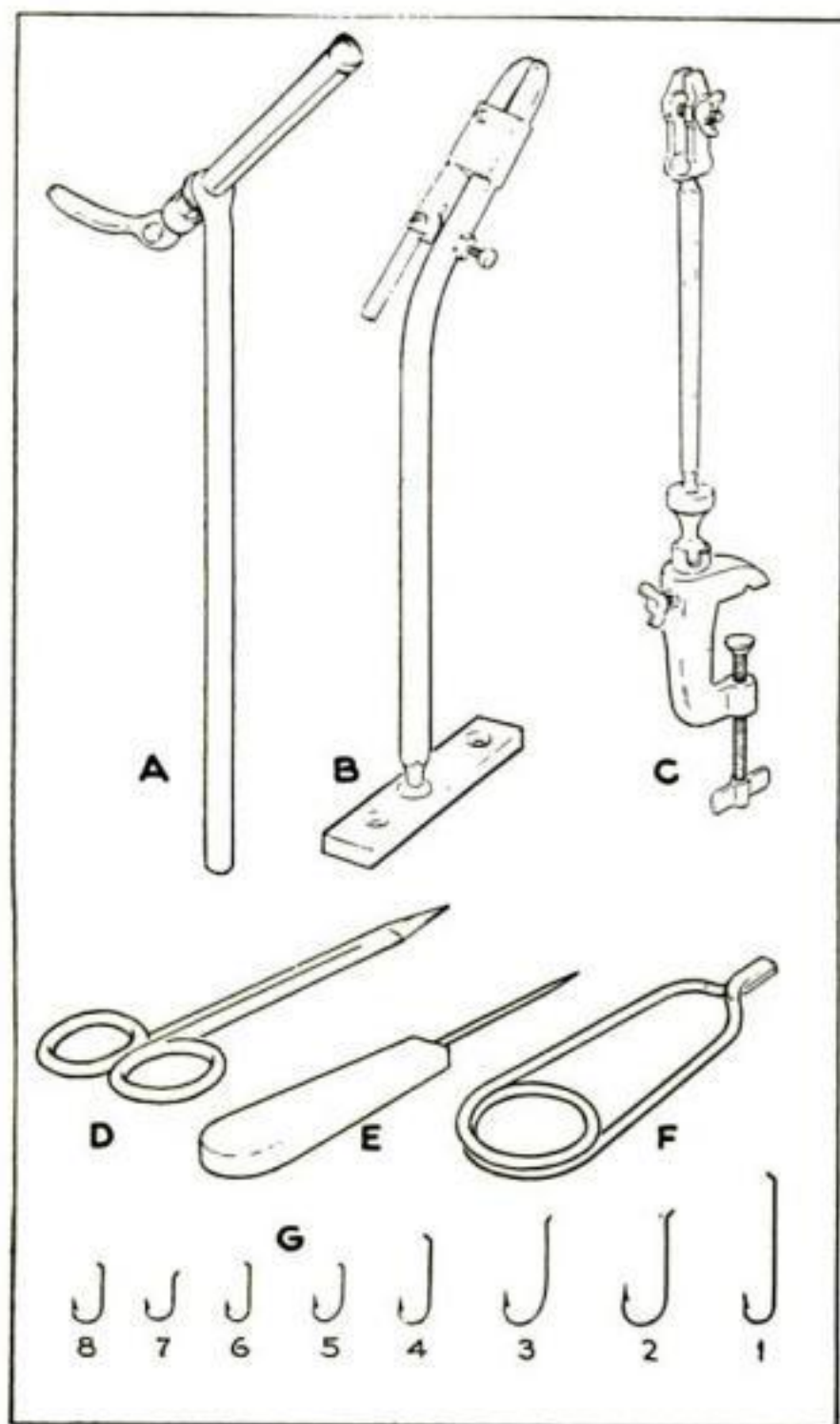


FIG. 1 SLIP KNOT

finger. That is all there is to the knot.

The Special Whip Knot. This is used for all important tying such as attaching wings and finishing off the head of a fly. After the thread is attached to the hook, the loose end is held in the left hand as shown at A, Fig. 2.



Three types of fly-tying vises and three other essential tools—scissors, "dubbin needle," and hackle pliers. Hooks come in a variety of styles and sizes

Then, put the right forefinger under the thread and make a bend in the thread by pulling the right forefinger up toward you against the thread. With the left hand, bend the thread away from you toward the right of the vise and over the top of the hook, keeping the pressure on the bend with the right forefinger. Continue the movement with the left hand over the hook and back to the right forefinger.

The bottom thread of the loop thus formed is now grasped by the forefinger of the left hand and the left thumb, together with the loose end of the thread, as at B. The right hand now takes the top part of the loop as shown and starts winding it over the top and around the hook as at C. Remember that the end of the thread and one side of the loop must be held taut with the left hand while the loop is being wound over the hook shank.

Two or three windings of the loop are sufficient to insure good holding power in most cases. For extra security, you might add one or two more. After the wind has been completed, take the dubbin needle and insert the point in the loop with your right hand as at D. When you have the pressure applied, release the side of the loop held in the left hand, but keep hold of the loose thread end. Now pull the loose thread end against the needle and let the needle follow down to the hook shank. There take out the needle and pull tight.

Now let us tie a typical dry fly. We'll make it a very popular one—the Fan-Wing Royal Coachman. A drawing of it, with the nomenclature, appears at the top of the illustration on the preceding page.

First tie in the tail, using golden pheasant tippet fibers as shown at A, Fig. 3. Second, place on the wings, which are mandarin-duck breast feathers. Bind them on with the stems down straight as at B; then bend the stems back as at C and tie in securely, close to the wings. Now cut off the surplus ends



FIG. 2 WHIP KNOT

Next, tie in the hackles, which are brown for this pattern, as shown at *D*. Use one hackle for a sparse-hackle fly or two hackles for a well-hackled fly. When using two, face the glossy sides of the hackles together. This will bring the slant right for a well-balanced hackle. Even if you want a sparse fly, two hackles back to back and wound sparingly are better than one hackle.

Now we leave the hackles as they are and go back to the tail, where we start the body as shown at *E*. The material shown is peacock herl (the barbs of the feather). Only one little ridge on the body is made here. It is tied in with the slip knot, and the end is cut, leaving the rest of the hook bare.

Next, wind in a short section of scarlet floss as at *F*, after which another knob or

ridge of peacock herl is wound on the opposite side of the floss. It is now time to wind in the hackle as at *G*. The completed fly should look something like sketch *H*.

All regular dry-fly patterns with upright or spent wings or without wings may be tied with this general routine. When tying flat wings (see illustration among the general types of flies), the procedure used for streamer flies (to be described in the following installment of this article) is necessary, and the hackle is placed and wound on last.

Putting on a Double Wing. First, select a pair of quill feathers of the color desired, one from each side of a bird. Second, cut two sections from each feather as shown at *A*, Fig. 4. One set appears as cut; the other

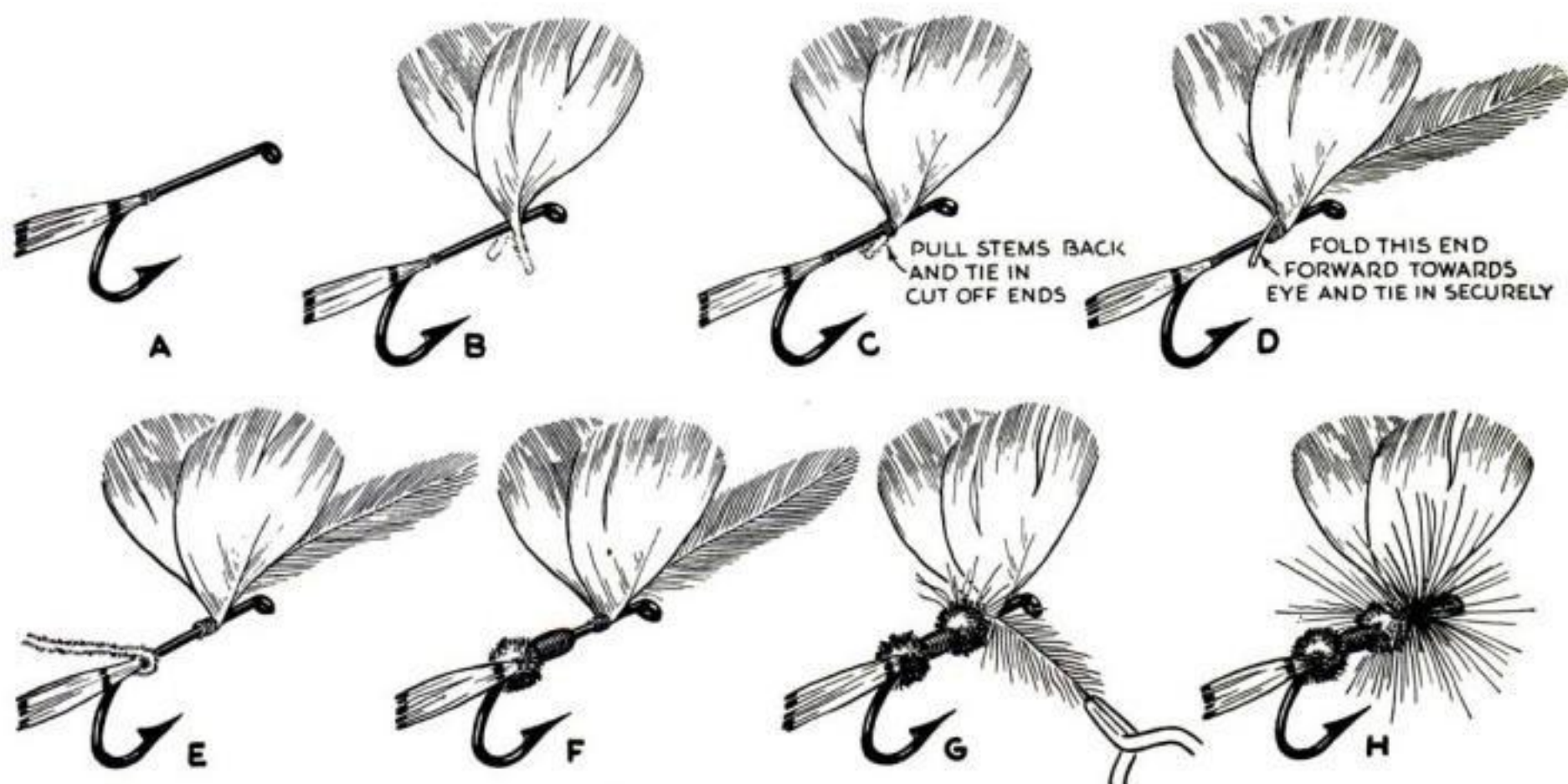


FIG. 3 FAN-WING ROYAL COACHMAN

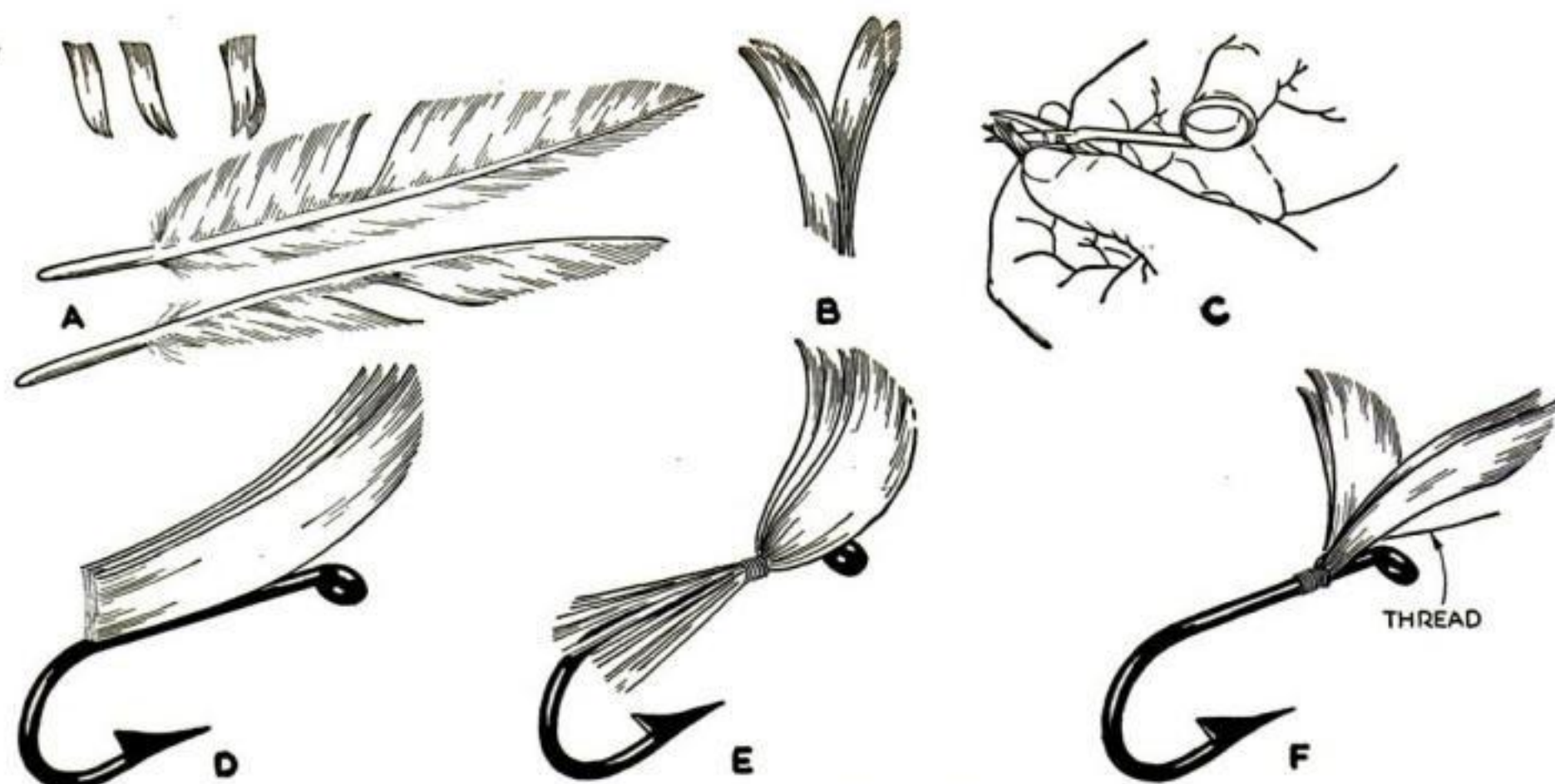


FIG.4 DOUBLE WING

set is paired. Placing the two separate pieces together, we now hold all four so that the shapes conform as shown at B. Holding them tightly with thumb and forefinger of the left hand, we shape the ends with scissors as at C. We now place them on the hook shank as at D. When tied, they look something like sketch E. After this we divide the feathers with the thread as at F, tie in securely, and cut off the ends.

When tying on the wing as shown at E, you are likely to bring all four feathers to-

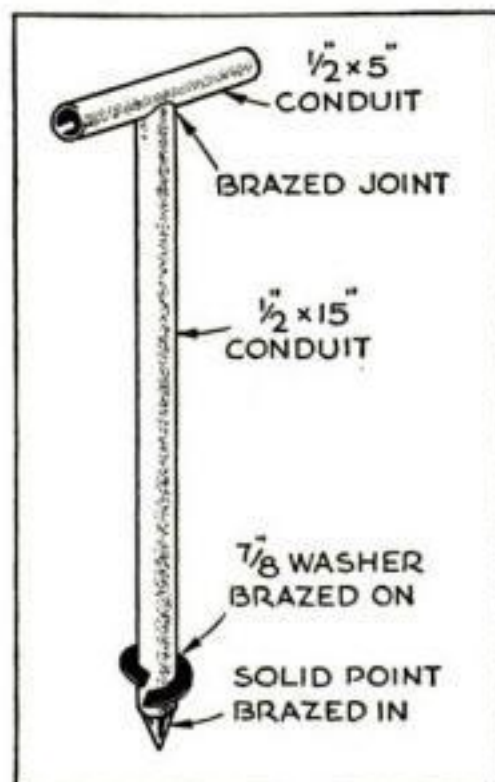
gether. If so, separate the left and right pairs with the dubbin needle and immediately hold them apart with the thread. (TO BE CONCLUDED)

Sharp Nail Clipper Trims Flies

TO TRIM old, shaggy fishing flies or even the edges of feathers used for new flies, I have found that a sharp finger-nail clipper of the lever-operated type gives a very clean cut.—H. P. MILLER.

Small Metal Tie-Down Stakes Screw Firmly into Hard Ground

TIE-DOWN stakes for use at airports or as tent stakes in localities where high winds prevail can be made as shown. Once screwed into hard ground, they cannot readily be wrenched out even by violent gusts of wind. Each pin consists of two pieces of $\frac{1}{2}$ " thin-wall conduit, a steel point turned in the lathe, and a $\frac{7}{8}$ " iron washer sawed diagonally so that it can be spread open to form a thread like that on an auger. The parts are brazed together.



REPLACING A FLATIRON ELEMENT

[ELECTRICAL]

If a series test lamp fails to light when its terminals are placed across those of a flatiron, an open circuit is indicated, and possibly a burned-out element. The steps in replacing the element are as follows:

Remove the two screws on top and take off the outer casing. In some irons the terminal straps are attached to this part, and must be disconnected before the casing can be lifted clear. Take out the two screws holding on the pressure plate. Under this will be found the mica-covered element. If the resistance wire is found to be broken or burned through, a new element should be installed. (Probably a so-called "universal type" element will fit, and this can be obtained from almost any dealer in electrical supplies. In some cases, however, it may be necessary to obtain a new element from the manufacturer.) Cover the terminal straps with the insulating braid provided. After assembling the iron, test again with a series lamp. Current should flow through the two terminal prongs, but the lamp should not light when the test leads are touched to either terminal and the flatiron body.

POPULAR SCIENCE MONTHLY



TRANSFERRING PRINTED MATTER

[FORMULAS]

Printed matter and pictures can be transferred from newspaper and magazine pages by using transfer liquids to soften the ink. A simple method is: (a) Rub soft soap on the inked area, being careful not to smear, and let it stand a minute or two; (b) place a damp paper on the printed matter, back the two with a sheet of glass, and rub with a hard object such as the back of a spoon, or roll with a paper hanger's seam roller.

For a more universal transfer liquid, dissolve $\frac{1}{4}$ oz. of granulated laundry soap or common yellow soap in 16 oz. of hot water, cool, add 3 oz. of turpentine, and bottle. Shake well before using. Then (a) wet the printed area with cotton or a brush dipped in the transfer liquid and let it stand two to five minutes; (b) apply transfer liquid to plain paper, and wipe or drain off the excess so that the paper is damp but not wet; (c) place the plain sheet over the print, and roll or rub into absolute contact.

The best results are obtained when transferring printing from newspapers and other unglazed paper. For print on paper such as used by POPULAR SCIENCE, greater pressure is required.

The transferred image will be reversed, of course, and can be transferred a second time, or tough tissue may be used and mounted on a white backing. The transfer may be washed to remove soap when retouching is necessary.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

ONE of the commonest troubles that can come to a house is dampness in the cellar. It may vary from a gentle perspiration to a Mississippi flood. But even mild dampness that continues may cause serious trouble. Nothing should be left in a damp cellar that can rust or mold.

One cause of dampness that is not always recognized is condensation caused by the contact of warm, damp air with the cool masonry of the walls and floor. When drops of water appear on the walls and drip to the floor, it is natural to suspect a leak, but the real cause can be shown by sticking a sheet of metal foil to the wall in the center of a wet place (that from a pack of cigarettes will serve, although a piece a good bit larger is better). If the outer surface of the foil remains dry after 12 hours, condensation can be ruled out as a cause of dampness. If, on the other hand, drops do appear on the outside of the foil, they must be due to condensation, because leakage from the wall could not pass through the foil.

Condensation can be prevented by sheathing the masonry with insulation, such as plaster on furring strips and lath, to provide a layer of dead air, or by using stiff insulating sheets, tightly fitted wood sheathing, or anything similar. No kind of paint or similar coating will stop condensation, because it would have the same effect as the masonry itself.

No test is needed to identify a real leak, for a crack in the wall, an open joint between walls and floor, or porous places in mortar or concrete can be easily seen. The extent of leakage through a crack depends on the water pressure against it. When a house is built on low ground and on soggy earth, this will be great enough to force water through even tiny cracks in the walls and floor or through porous concrete, mortar, or bricks.

Pressure will depend on the outside conditions and natural drainage. Thus there will be little or no dampness in a cellar when the earth is sandy or loose and the house is on high ground, for water will sink in too rapidly to collect and exert pressure. Trouble comes when water forms pools against the foundation walls and works its way under the house. The pressure may even be enough to crack the concrete floor. This can be avoided during construction by filling the excavation outside the wall with solidly packed earth instead of the usual loose fill of chunks of plaster, concrete and wood, stones, discarded bricks, and other rubble, for these provide plenty of spaces in which water can collect. This condition, in fact, is one of the commonest causes for damp cellars.

Water may come from surface drainage,

Wet Cellars..

AND WHAT TO DO ABOUT THEM

By ROGER B. WHITMAN

Home-building expert and
author of *First Aid for
the Ailing House*



from rain beating against the house walls and running down, and from the discharge of rain-water leaders so close to the house (less than 15') that water finds its way back to the fill. One remedy is to excavate, lay drain tile at the wall footings to discharge at some lower point, and repack with solid earth. While the excavation is open, the outside of the foundation walls should be given a coat or two of tar or pitch.

An alternative is to pack solid earth against the walls to form a bank 2' or 3' high and 8' or more in width. When this is grown with grass, water will drain away from the house instead of sinking in close to the wall. Results may not be as sure as those obtained by excavating and laying drain tile, but they are usually effective. Another remedy is to lay a concrete walk about 3' wide around the house, on a slight slope from it and solidly bonded to the foundations. All depressions in the earth

within several feet of the walk, such as low places around shrubbery and other plantings, should be filled.

A leak through the joint between the walls and cellar floor shows that water is collecting under the floor. Such leaks can be checked by filling the joint with roofing cement. This is most easily done by melting the cement and pouring it in from an old tin can with the open end bent to form a spout.

Water under a floor may come from a spring or underground watercourse. Getting rid of it may call for the laying of drain tile under the floor. If the ground is sloping, the discharge can be somewhere outside the foundation walls. On level ground it can be in a pit in one corner of the cellar, to be provided with an automatic sump pump to remove the water as fast as it collects.

When the natural water level in the ground is as high or higher than the floor level, as may be the case with a house on low ground and near a body of water, the surest way to keep the cellar dry is with membrane waterproofing. For this the floor and walls are covered with one or two unbroken layers of waterproof felt, stuck down and to each other with liquid asphalt, and

made resistant to water pressure by 3" or 4" of a rich mixture of concrete, reinforced with wire mesh.

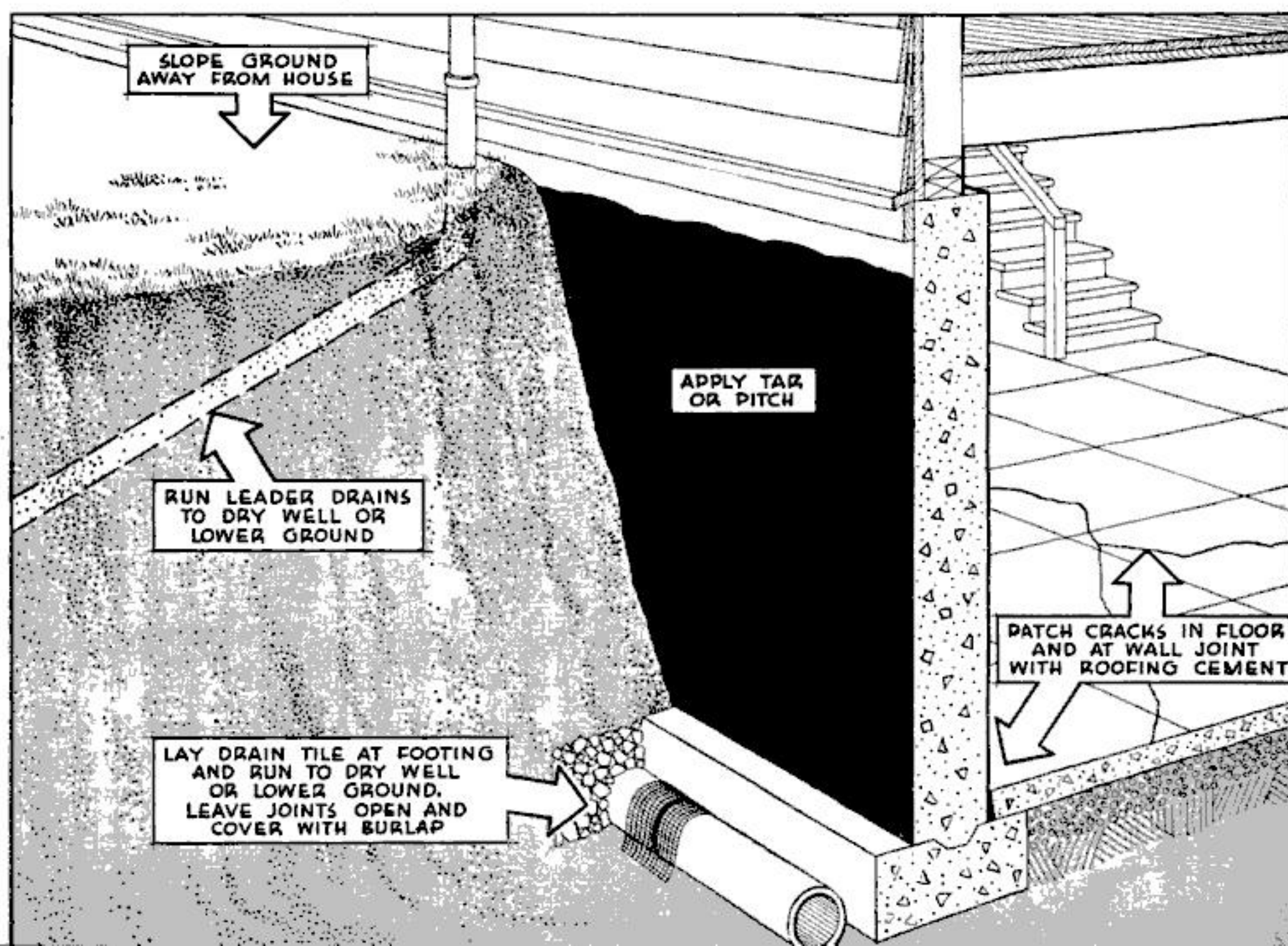
General leakage through a wall can be stopped from the inside by a coating of dense concrete which, to be effective, should be applied by an expert mason. Various special cements made for the purpose can also be used. Cracks in the walls, usually caused by unequal settlement, can be filled with mortar after settlement has ended.

Outside waterproofing is preferable to that on the inside, for it will keep the wall dry. With inside waterproofing, the wall itself will be continuously soaked, and in time might be injured.

When a house is built on a slope, surface water may run down and bank against the uphill foundation wall. Trouble can be avoided by laying drain tile along the footing of the wall and extending it to carry the discharge past the side walls.

A cellar with a dirt floor can never be made dry, even though the floor itself may appear so. Laying a concrete floor is the only real remedy. A simple method of waterproofing is to cover the dirt with a layer of heavy tar paper and to pour the concrete on top.

Wet cellars are cured by patching cracks and waterproofing the outside foundation walls, installing drain tiles, running the leader drains away from the house, and grading the ground to slope properly





Paint Your Home ON THE Four-Year Plan

By MAURICE WHARTON

FEW investments in the home pay off as well as regular exterior painting. Properly protected with a seal of good paint, the lumber used in the construction of your home will last almost indefinitely. Interior painting, apart from its protective and preserving services, is also a good investment because human happiness and efficiency depend partly on how well you like your four walls.

No paint job was ever better than the surface on which it was laid. Neglect of the wood in your home, inside and out, can never be corrected. The only satisfactory solution

is to paint the wood regularly.

To help you systematize your painting, whether you do your own or employ a professional painter, POPULAR SCIENCE offers the accompanying home-painting timetable. It represents, of course, a hypothetical average. Exterior painting has been figured on the basis of two coats once in four years. In temperate climates, provided that all wood is in reasonably good condition and house paint of best quality is used, this should be sufficient.

For protective purposes alone, interior painting and decorating does not have to be so frequent as shown in our "average" timetable. However, considering that apartment dwellers expect and often get complete interior redecoration annually, the private home owner should find it possible to renew kitchen and bathroom paint biennially and that in the other rooms once every three years.

To keep your home in really tiptop condition, a few items should be painted every year. If there are children, this would almost certainly include the front door. If you have a basement playroom or workshop with cement floor, one coat of rubber-base cement paint annually will keep it like new. Outside steps, the top surfaces at least, and porch floors subjected to a great

deal of wear should be included in the yearly once-over. Items needing annual attention will vary, of course, as will also the other factors in your own timetable. The important thing is to make a schedule and stick to it. This will avoid the necessity of turning the house inside out every few years for complete painting, yet will keep your home really shipshape at all times.

So much progress has been made in paint manufacture that it is sheer folly not to select the exact paint for whatever job you have to do, and buy the best grade of paint made. Any competent paint dealer will be

glad to advise just which types are best for what purposes. Don't economize on quality, and don't use general-purpose paints indiscriminately. Every kind of surface demands its own kind of paint.

Any time from April to November is, generally speaking, outside-painting time. Many painters prefer the late fall, after the hot summer sun has baked every bit of moisture out of the surfaces to be painted. Moisture is painting's worst enemy, and every precaution should be taken to insure its absence before work is begun. A week or more of dry weather is usually adequate.

Moisture will ruin a paint job at any time, even after the paint has thoroughly dried, if it gets into the wood under the paint. It is a good practice, therefore, to make sure cracks and gaps of all kinds are sealed up before the painting is begun. Any spaces between window frames and outside walls should be closed with caulking compound. Loose or cracking putty should be replaced.

Exterior wood should have two coats on repainting. Have all surfaces to be painted clean and smooth. If you live in a locality where much smoke and soot settle on the house and leave an oily film, it may be necessary to clean the old paint with a good paint cleaner before repainting. Let the first coat of paint dry thoroughly. Five to ten days, depending on the weather conditions, should be sufficient. Don't paint if you expect the temperature to drop below 40 deg. F., and avoid painting in direct sunlight.

In painting porch floors or other outdoor surfaces, be sure all cracks between boards are filled with white lead, to prevent the entrance of rain water or other moisture later. Put one coat of paint on the *underside* of the porch floor, as well as on other wood surfaces exposed to the air but hidden from view.

Drains and other metal surfaces must be completely cleaned of rust before painting.

Before painting the kitchen, it is essential to wash the walls with a solution to cut all grease film from the surface. Trisodium-phosphate washing powder is preferable, because ordinary soaps leave a thin film that may make the new paint peel later. The bathroom, too, should receive this treatment. Painted walls should be washed from the bottom up to avoid streaking. Glossy paint or enamel is best for the kitchen and bathroom while flat paints are preferable for bedroom and other painted walls. For woodwork, a semigloss paint is excellent.

It is not necessary to remove varnish from woodwork in order to paint it, unless the varnish is in bad condition. You must, however, dull the glossy surface of the varnish with steel wool or sandpaper, or wash it with a solution of one cup of washing soda in a pail of water.

In refinishing floors, many methods are possible. In general, it is desirable to remove the old finish, if in very poor condition, with a heavy floor-sanding machine, which leaves the wood like new.

In using any paints, enamels, varnishes, and waxes, it is important to observe strictly the instructions included with the product. Thousands of home owners, under the delusion that any old way will do, waste materials, time, and patience.

An attempt has been made to formulate a definite program of paint maintenance, but every home has its own individual conditions. If you will devote a little time, however, to planning a definite schedule of your own repainting needs, you will be pleasantly surprised to find how easy it is to keep your home always well groomed. With a year-to-year painting timetable, work, worry, and cost are spread out on easy-payment terms.

YEARLY TIMETABLE FOR HOME PAINTING

FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR
Exterior Touch-up work*	Kitchen and bathroom Living room, dining room, lower hall Touch-up work	Bedrooms Upper hall Touch-up work	Kitchen and bathroom Touch-up work
FIFTH YEAR	SIXTH YEAR	SEVENTH YEAR	EIGHTH YEAR
Exterior Living room, dining room, lower hall Touch-up work	Kitchen and bathroom Bedrooms Upper hall Touch-up work	Touch-up work	Kitchen and bathroom Living room, dining room, lower hall Touch-up work

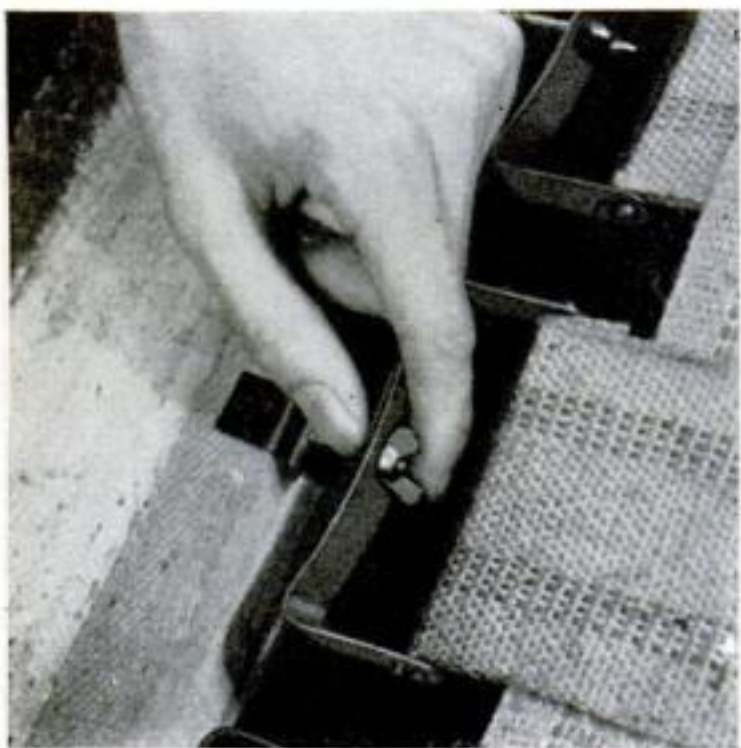
*"Touch-up work" refers to the repainting of surfaces exposed to especially hard wear, which require attention more frequently than called for in the regular schedule. Such surfaces include the front door, porch floors, outside steps, floors exposed to heavy traffic, window sills, and the like. Some touch-up work is required every year, but it will differ from year to year, since it is merely supplementary to the main painting schedule.

New Appliances



IRONER AND TABLE are an integral unit in the model shown above. Casters, which lock when the ironer is in use, permit it to be rolled into a corner or closet between times. The free-rolling ironing bar is 22" long and takes a large amount of work. Heat is controlled by thermostat. The built-in electric motor has a knee-action switch

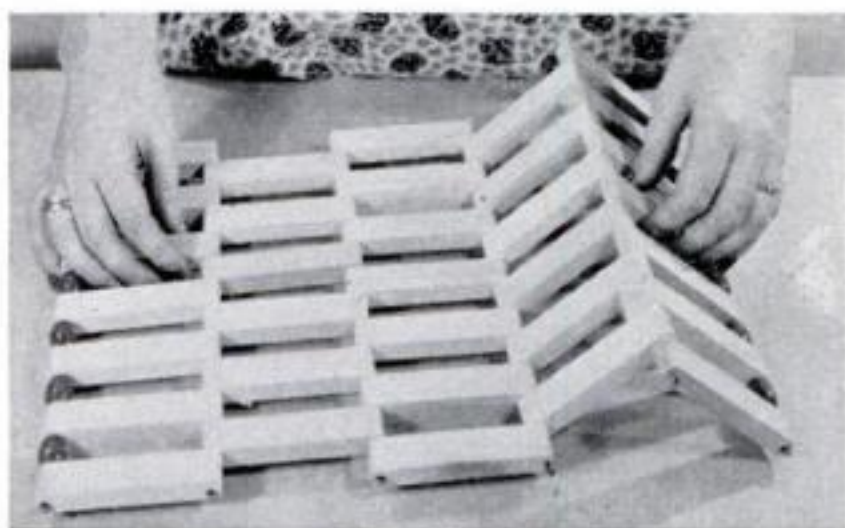
NONSAGGING CHAIRS now being shown are constructed with the bottom webbing locked to spring-steel shackles instead of being tacked. The adjustable shackles are bolted to the side of the frame and held with wing nuts, which are turned to regulate tension or correct sag



BAKING AND BROILING small amounts of food can be done on a single burner in the iron utensil below. It has a tight-fitting aluminum top. A cast-iron grill rests in the pan of the miniature range-top oven for use in broiling. V-shaped ridges drain the meat juice to the pan, which has a pouring spout



for the Household



COLLAPSIBLE DRAIN BOARDS made entirely of wooden blocks attached in series on metal rods fold compactly for storage, as shown above, when not in use. The blocks in a row near either side are thicker than the others, keeping the "board" just enough off the level to allow water to drain through to the sink. The finish is natural wood with colored beads

EXTRA STORAGE SPACE for canned or other foods that do not need chilling is provided on top of the refrigerator in a special accessory cabinet made by one of the large manufacturers to fit its six-cubic-foot models from 1937 on. It contains a multishelf arrangement which gives six cubic feet of additional space, and is designed to be anchored firmly on the top without requiring bolts



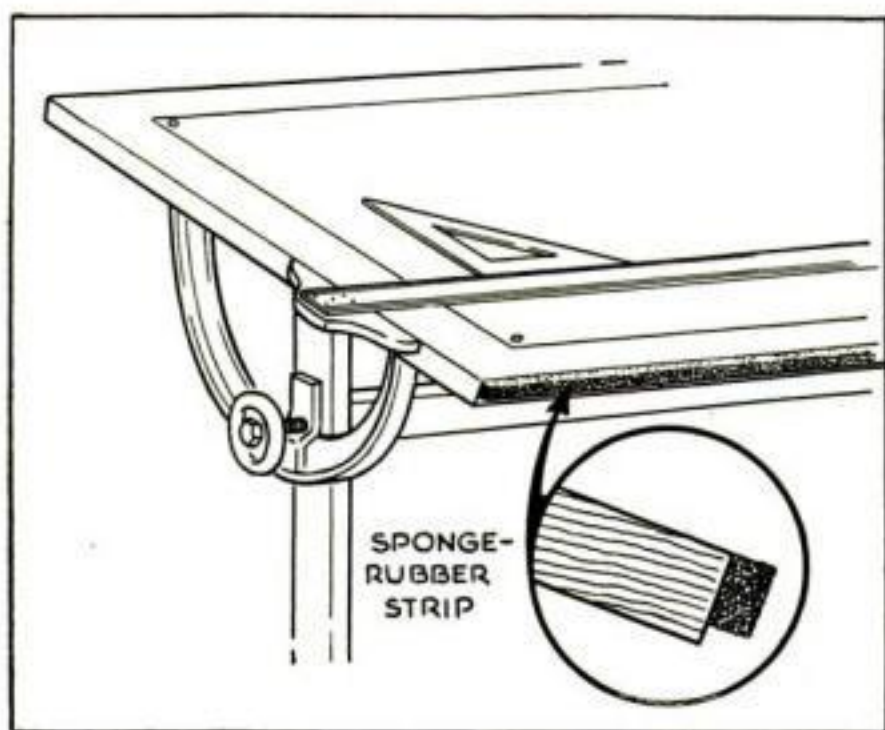
LIGHT ENOUGH TO BE CARRIED from room to room, this hand-model vacuum cleaner can be used with its wide variety of attachments for general and special cleaning, paint spraying, and closet demoting. An extension tube and nozzle make it

easy to reach draperies, moldings, and other high places. Other attachments include an extension hose, brushes, and a rubber nozzle for radiators. Its light weight is a help in cleaning furniture, stairs, Venetian blinds, and automobile upholstery



Salt-Filled Tubing Is Readily Cleaned After Being Bent

ALTHOUGH sand is often used to fill soft tubing so that it will not collapse when being bent to shape, table salt is better for the purpose. It supports the walls well and enables any reasonable bend to be made without becoming kinked. Any salt that does not readily pour out after the tubing is bent can easily be dissolved by running some water through the piece. On auto and tractor work this eliminates the possibility of grit remaining in gas or oil lines.—B. N.



Soft Rubber Strip Pads Edge of Large Drawing Board

WHEN working at a large drawing board, a draftsman frequently leans against the front edge, which may be uncomfortably sharp and hard on clothing. It therefore pays to pad this edge with sponge rubber cut from a kneeling pad. Attach this by coating it and the board with rubber cement, letting this dry completely, and then pressing the rubber into place.—AXEL E. OGREN.

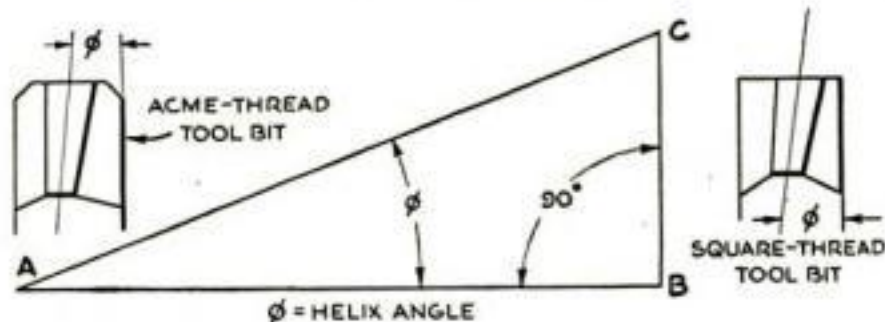
TO MAKE wood screws hold in oversize holes, plug these with insulated flexible wire. Use two twisted pieces for big holes.—E. N.

HELIX ANGLE FOR ACME THREADS

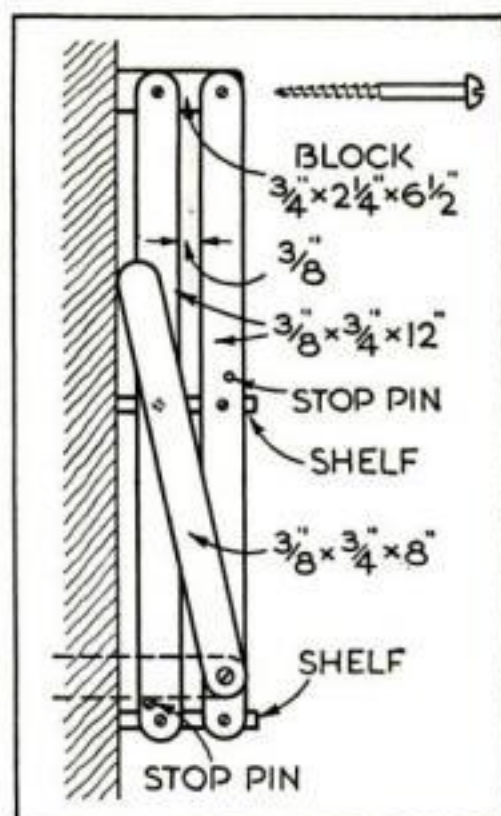
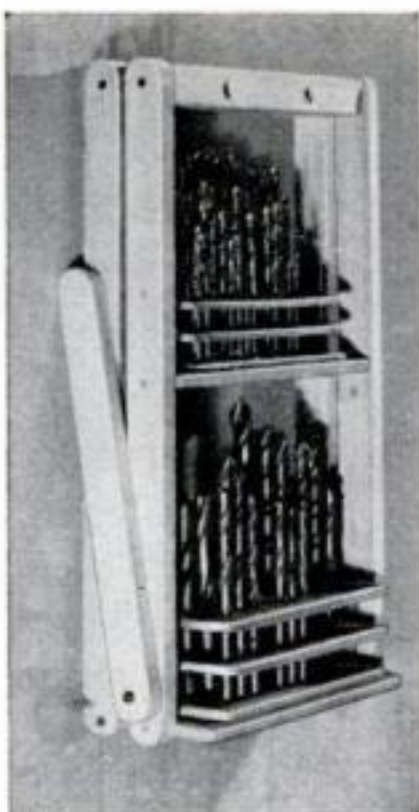
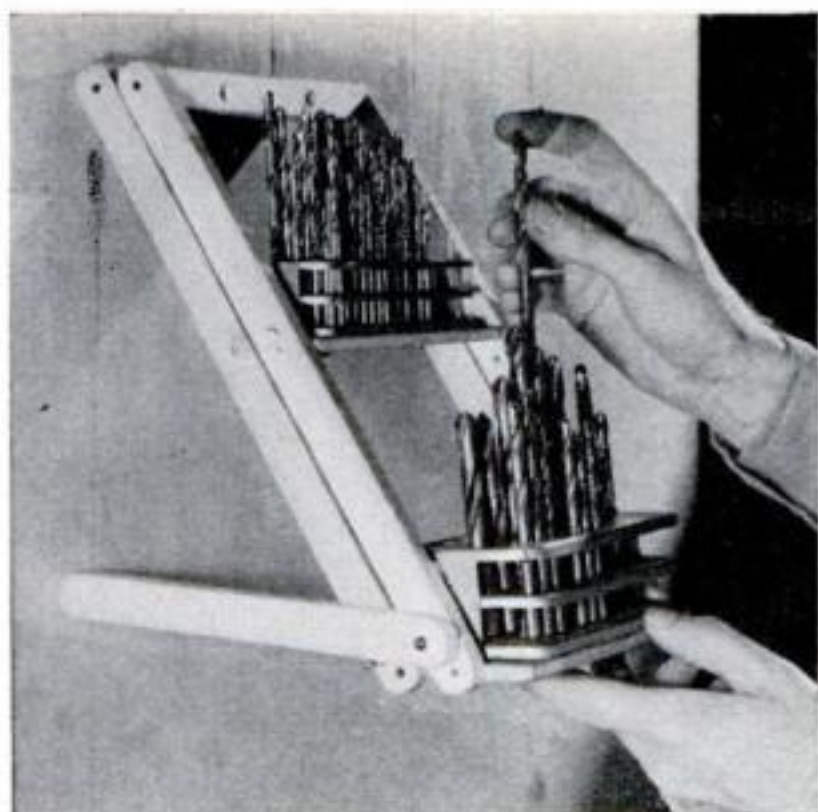
[LATHE WORK—26]

To determine the angle for grinding Acme- and square-thread tools, draw line $A-B$ equal to the circumference of the thread (3.1416 times the major diameter). Then draw line $B-C$ at 90 deg. to $A-B$ and equal

in length to the pitch of the thread (or to the lead if a multiple thread is to be cut). Draw line $A-C$ connecting the lines so drawn. The angle $C-A-B$ is the helix angle of the thread and the basic angle used in grinding the tool. However, in actual practice the sides of the latter are ground with a little side clearance to afford necessary relief for the cutting edge.



POPULAR SCIENCE MONTHLY SHOP DATA FILE



Swinging Shelves Hold Drills Out of the Way on Shop Wall

TWIST drills in metal stands are kept within easy reach on these shelves attached to a wall, where they take up no bench space and cannot be lost amid a litter of other tools. A pull on the lower shelf opens the rack as shown, and a brace drops automatically to hold it so.

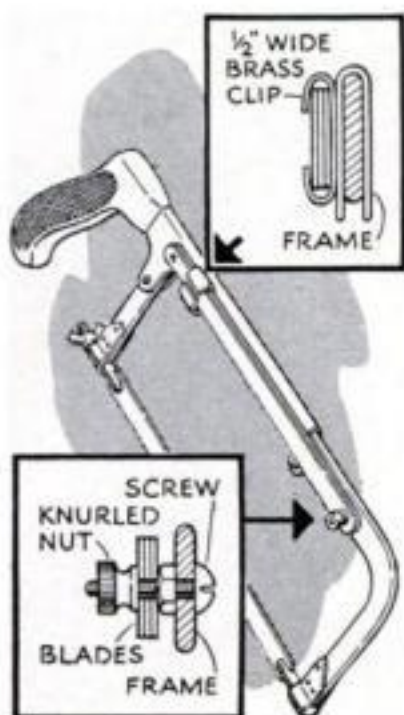
The shelves, which are of $\frac{1}{4}$ " plywood and

slightly larger than the drill stands, are suspended from a block by four wooden arms. Use small screws and washers at all joints so that the parts move freely. A small nail in the rear arm serves as a stop for the brace, and a second one higher up in the front arm prevents the brace from dropping toward the front.—WALTER E. BURTON.

Extra Blades Held in Reserve on Frame of Hack Saw

HACK-SAW blades of several different sizes to suit a variety of work, as well as extra blades for use in case of breakage, may be kept handy by carrying them on the frame of the saw itself. A C-shaped clip of $\frac{1}{2}$ " wide

brass is soldered on the frame near the handle, as shown, to hold one end of the spare blades. The other end is fastened by means of a small bolt, for which a hole has to be drilled in the frame. The end holes in the blades are slipped over the bolt, and a knurled nut, such as one from a discarded dry cell, secures the blades.—B. K.



...

CRACK filler mixed with vinegar instead of water remains soft for some time in bulk, but sets soon after application.—A. B. ROGERS.



How to Adapt Sharpener for Drafting Use

TO ADAPT an ordinary hand pencil sharpener for sharpening drafting pencils, remove about $\frac{3}{16}$ " from the end of the blade. The

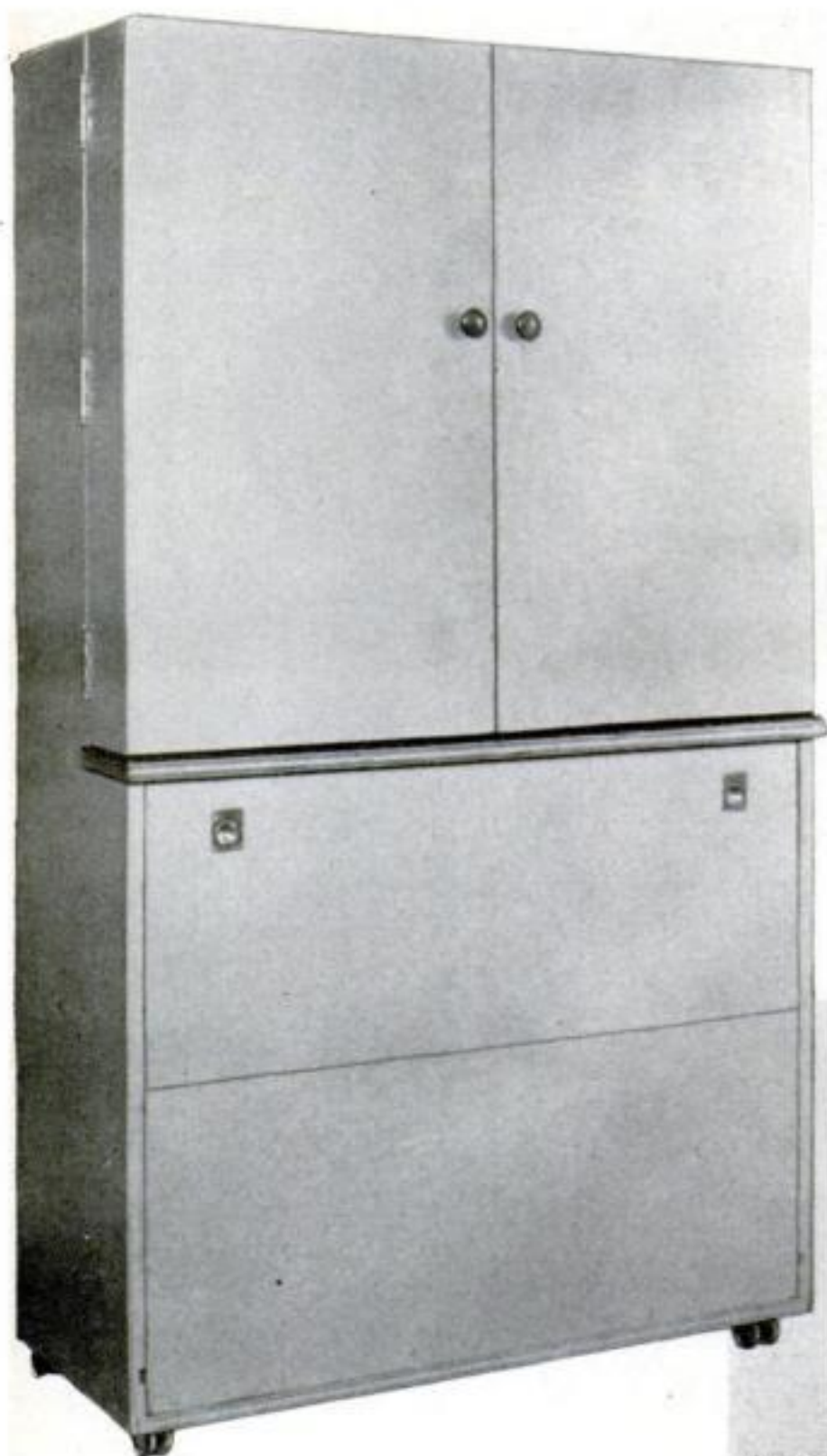
sharpener then will shave only wood from the pencil, and the lead may be shaped with a file or sandpaper. The length of the exposed lead can be made as long as desired by the draftsman.—EUGENE MERKIN.

Compound Rest Set at Angle Gives Vernier Tool Feed

FOR some types of lathe work, it is well to remember the following figures, which are accurate enough for most purposes: When the compound rest is set to an angle of $87\frac{1}{2}$ deg., each .001" graduation will advance the tool crossways .0001". Also, when set at 61 deg., each .001" graduation will advance the tool crossways .01 mm.—R. H.

Durable Plywood Cabinet

KEEPS TOOLS READY FOR USE

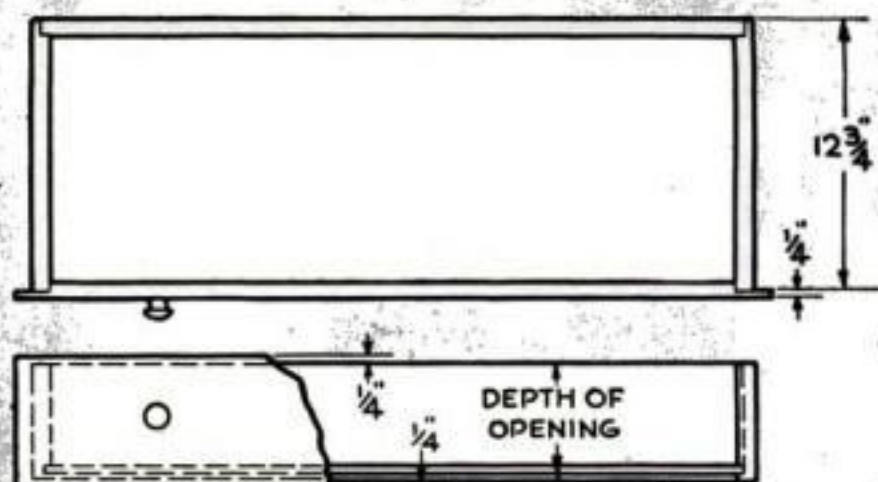


Closed, the unit presents a neat, modern appearance that is an asset to any shop. It can be constructed entirely of plywood

There is no greater aid to an orderly workshop than a well-designed tool cabinet. Here's one that is easy to build and has ample capacity

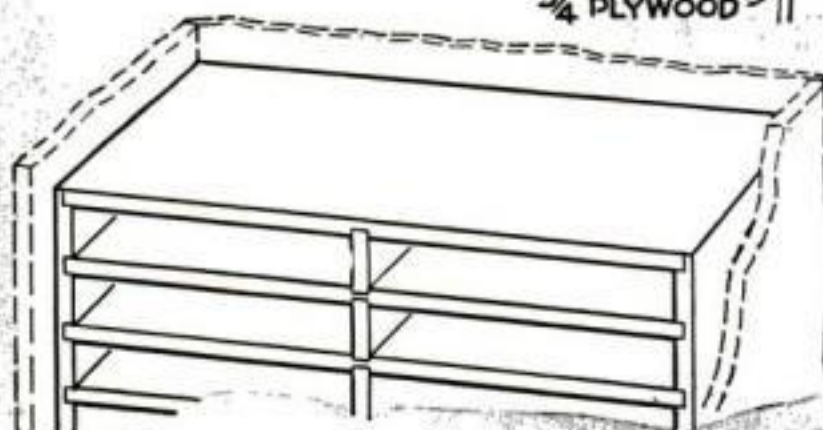
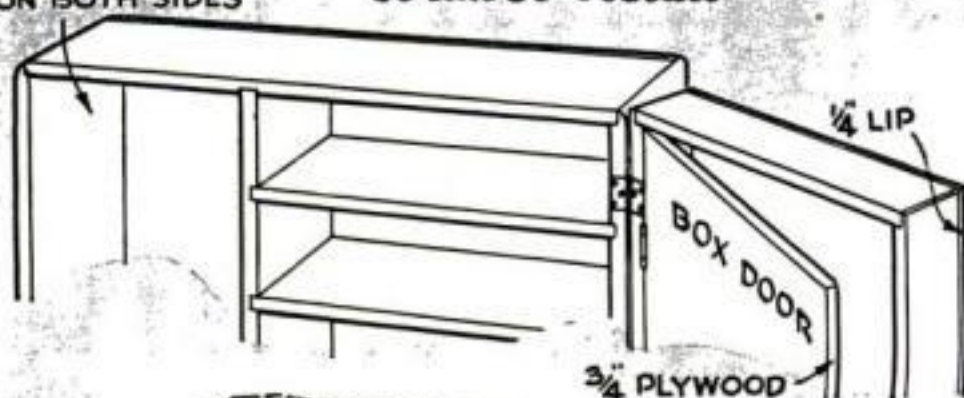
THIS plywood tool cabinet is a compact storage place of modern design for holding the main group of tools used in a well-equipped home workshop. The only machine used in its construction was a circular saw.

The cover front of the lower section, it will be noted, folds up at the center when not in use and slides back into the compartment marked A in the drawings. The two parts of the cover are put together with a piano hinge. When placed in position before the drawer case, the cover is held by two bullet catches at the top and one on each side, and by two steel dowel pins that fit into holes in the bottom board. On the upper section, two box doors cover the shelves and saw compartment. Each door has a plywood panel on which small tools may be mounted. The cost of all materials was less than \$20.—T. C. HOLMSTROM.

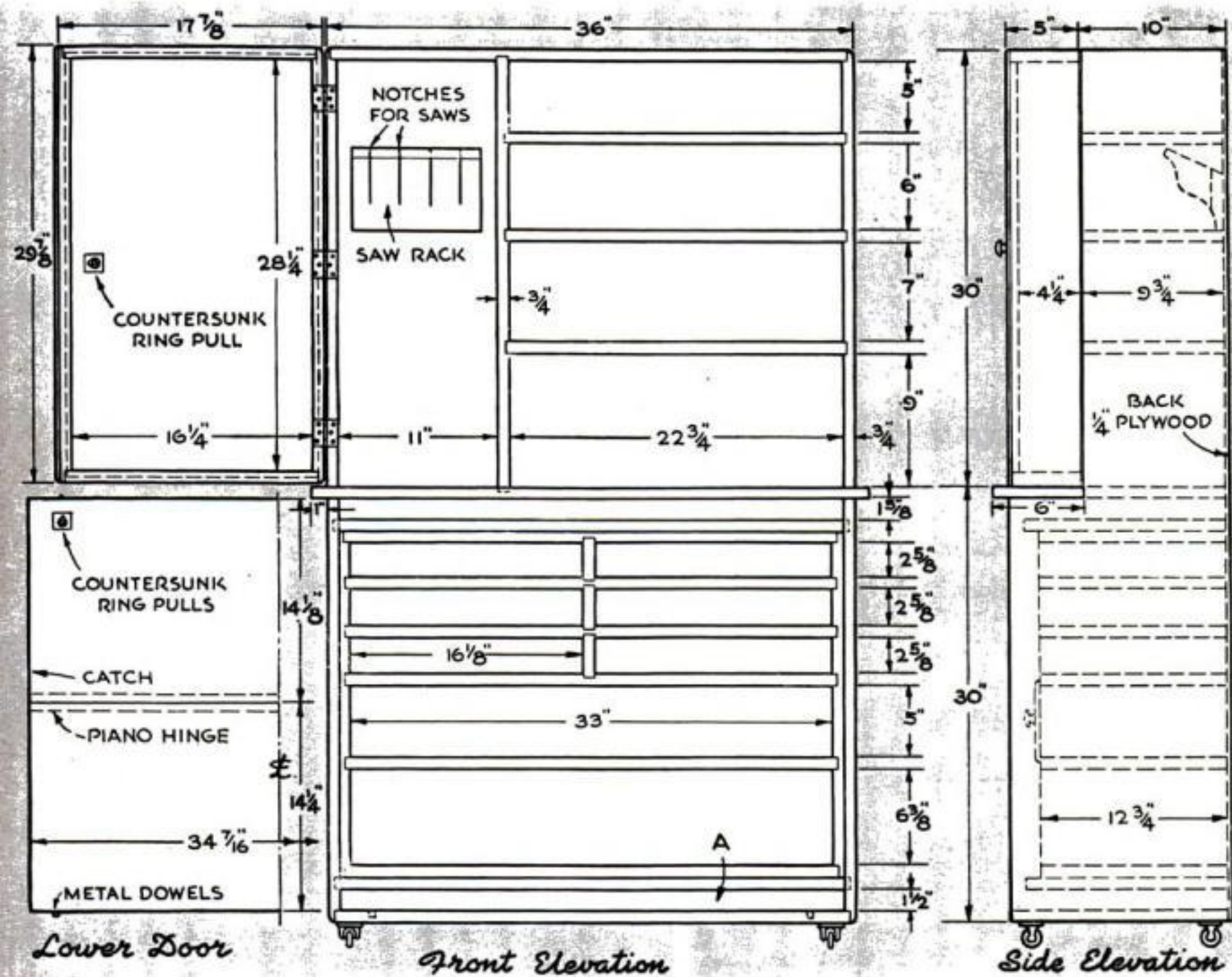


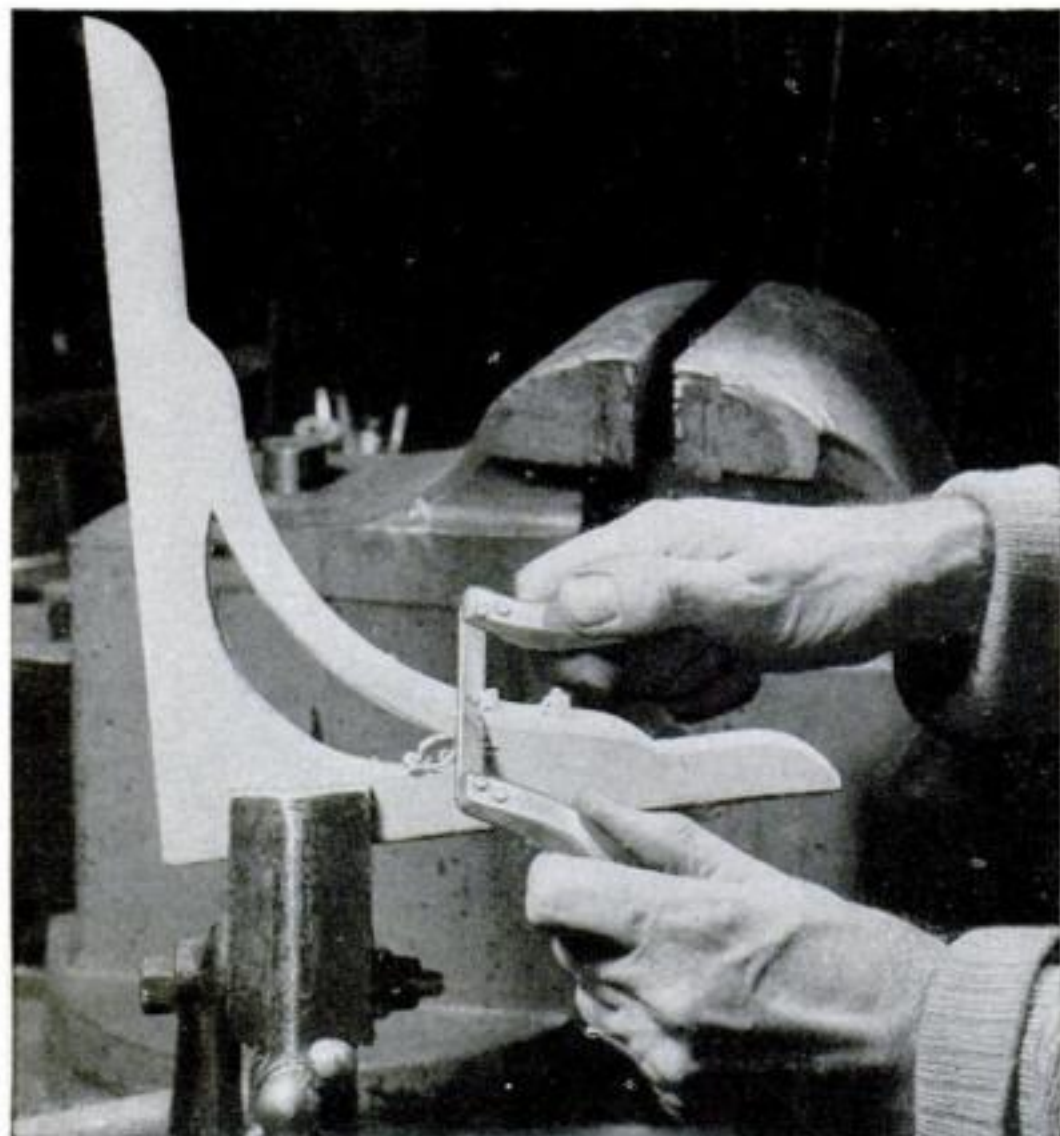
IDENTICAL DOORS ON BOTH SIDES

Drawer Detail



Drawer Compartment





Midget Drawknife FOR CARVING AND MODEL MAKING

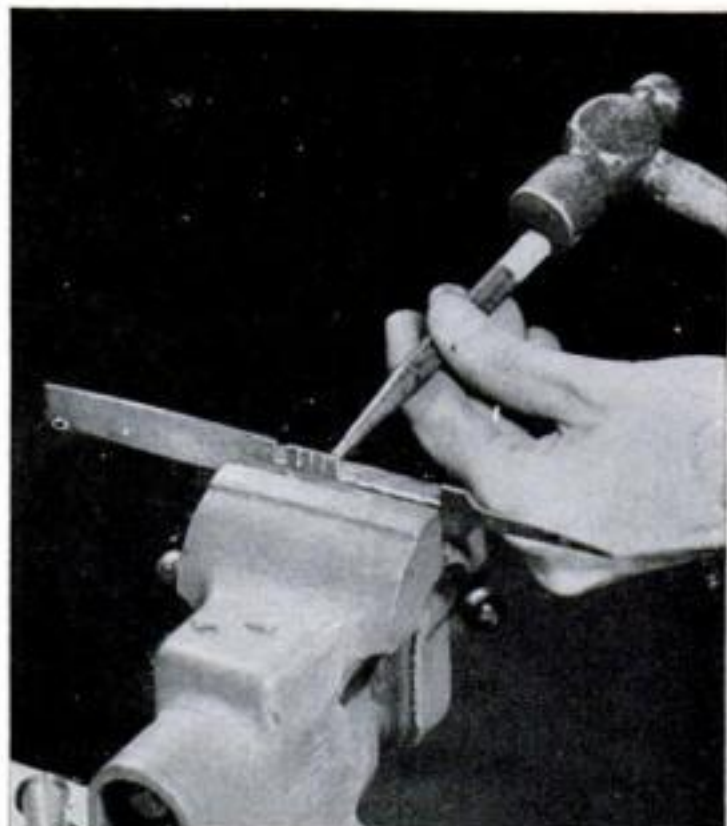
ONE of the handiest tools for wood carving is a midget drawknife with a blade about $\frac{3}{8}$ " by $2\frac{1}{2}$ " and $\frac{5}{64}$ " thick. It can be made from a small, flat file.

Heat the file red-hot and allow it to cool slowly to soften the steel. With a cold chisel, mark off the length of the blade, cut parallel slots about $\frac{3}{16}$ " apart with a hack saw, and knock out the lugs one by one with a punch. Forge or grind the steel to either a chisel or a knife edge, as shown; saw off the tang, remove excess metal from the other end, and drill four holes for rivets, countersinking these on one side.

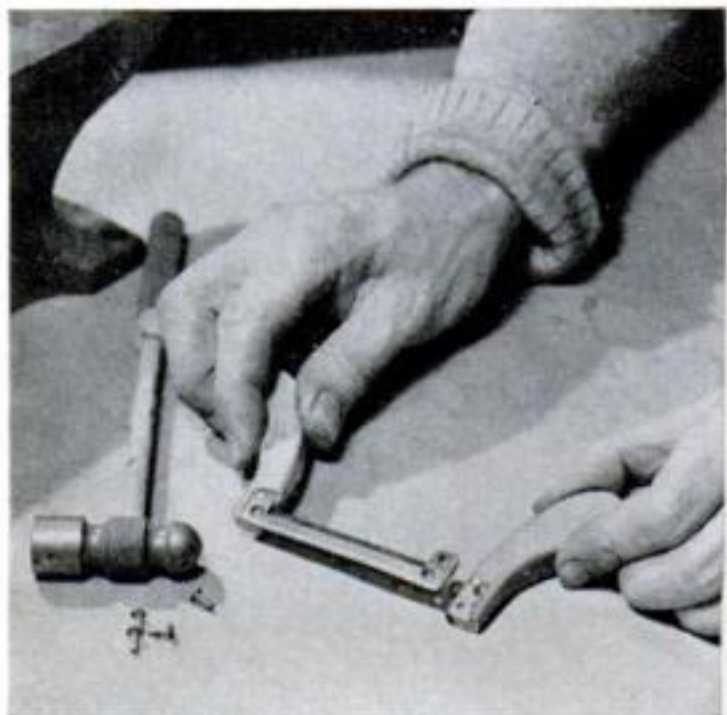
Harden the blade by heating it evenly until it looks red in medium-bright light and plunging it into water. Temper by reheating until a spot previously polished with abrasive cloth shows a brownish purple; then quench it in a mixture of two parts motor oil and three parts linseed oil. Hone the blade to a sharp cutting edge.

Cut and shape handles of maple as shown, and recess them for the ends of the blade. Drill holes in the wood to be a snug fit for small iron or brass rivets with large, round heads. After assembling, file and sand the handles even with the blade, and give them two coats of clear lacquer. The beveled side of the blade may be mounted either toward or away from the handles.

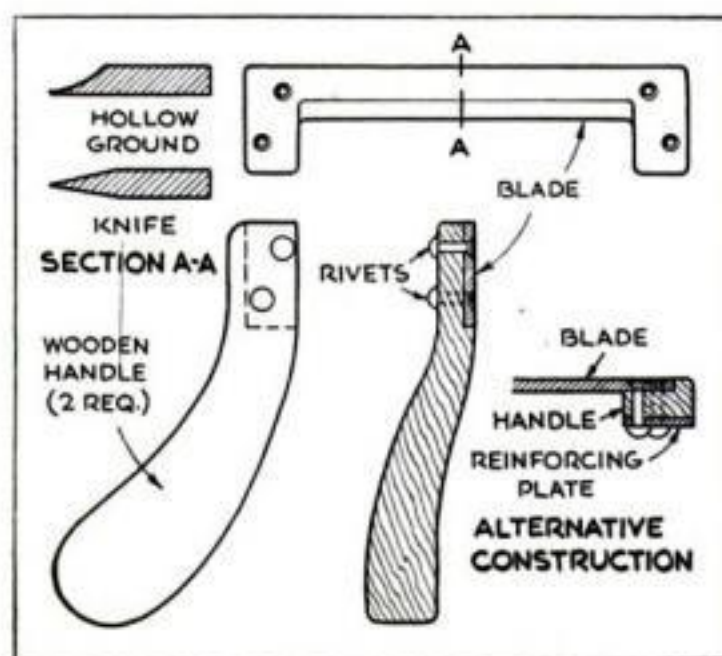
Several little drawknives, with handles set at different angles and blades of various sizes, will be a convenience. A thin-bladed drawknife can be worked in places inaccessible to a conventional spokeshave.



After its temper has been drawn, the file is easily slotted with a hack saw. Knock out the series of lugs, as above



Attach the handles to the blade with four rivets. Back these up solidly to hammer them down flush with the steel



Dimensions are omitted, as the tool may be any size desired. Metal reinforcing plates under rivet heads add strength



3

TONGUE $\frac{1}{4}$ THICK

$1\frac{7}{32}$

.572

.700

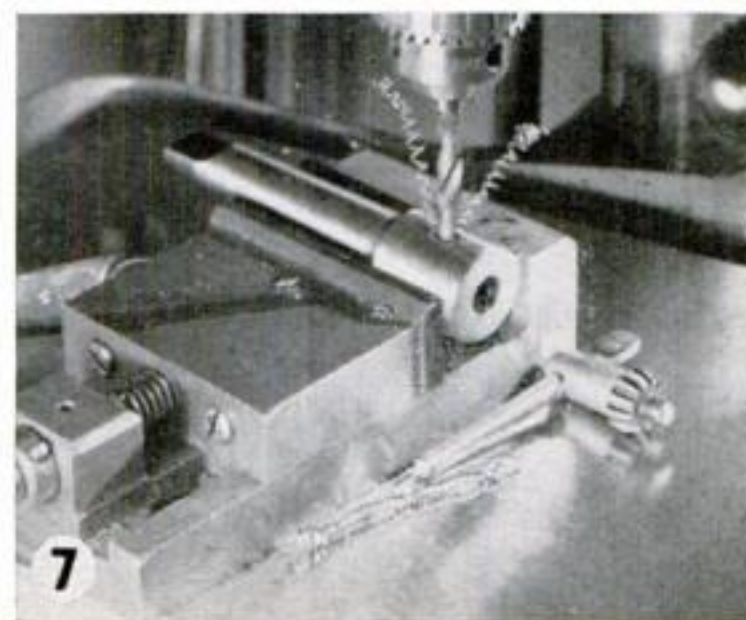
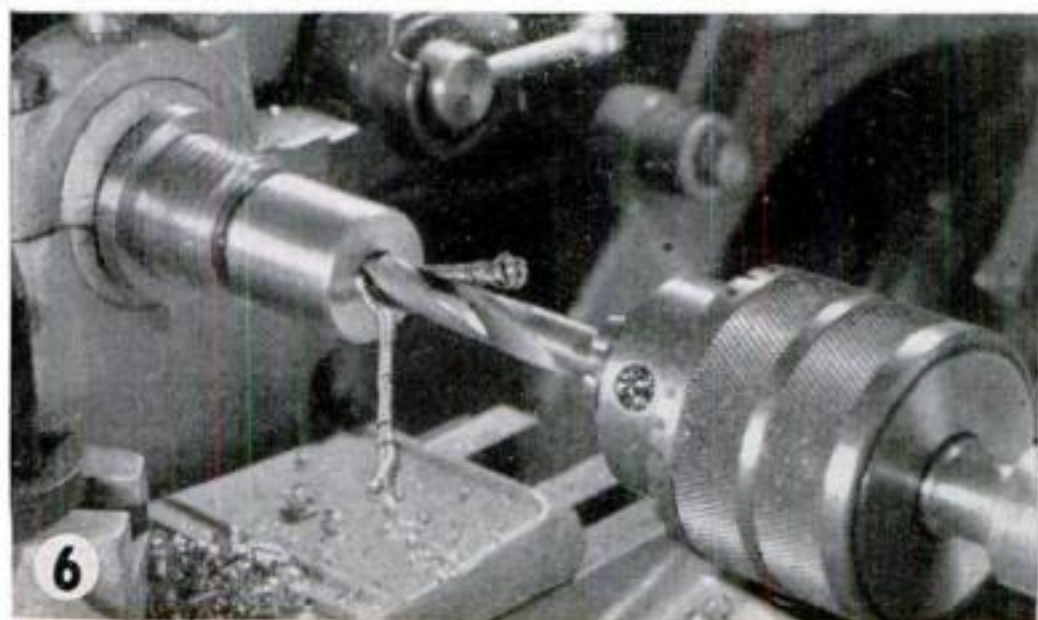
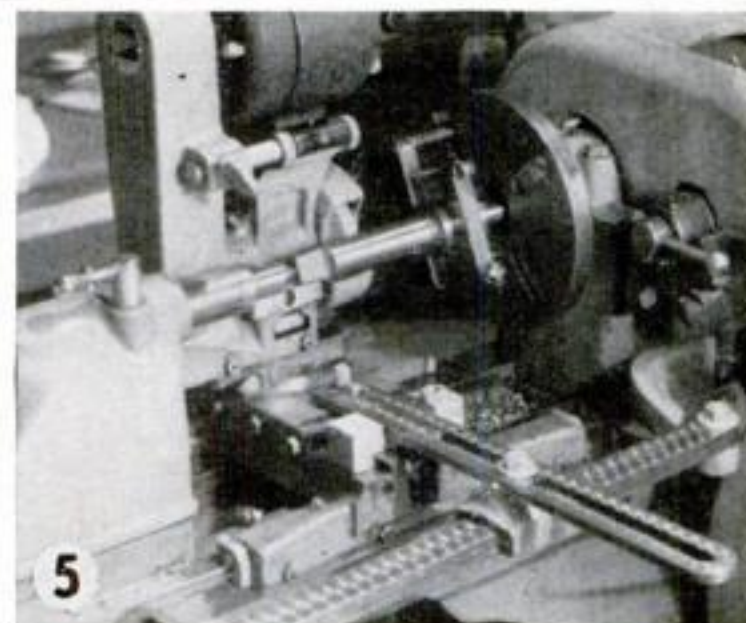
No 2 MORSE TAPER

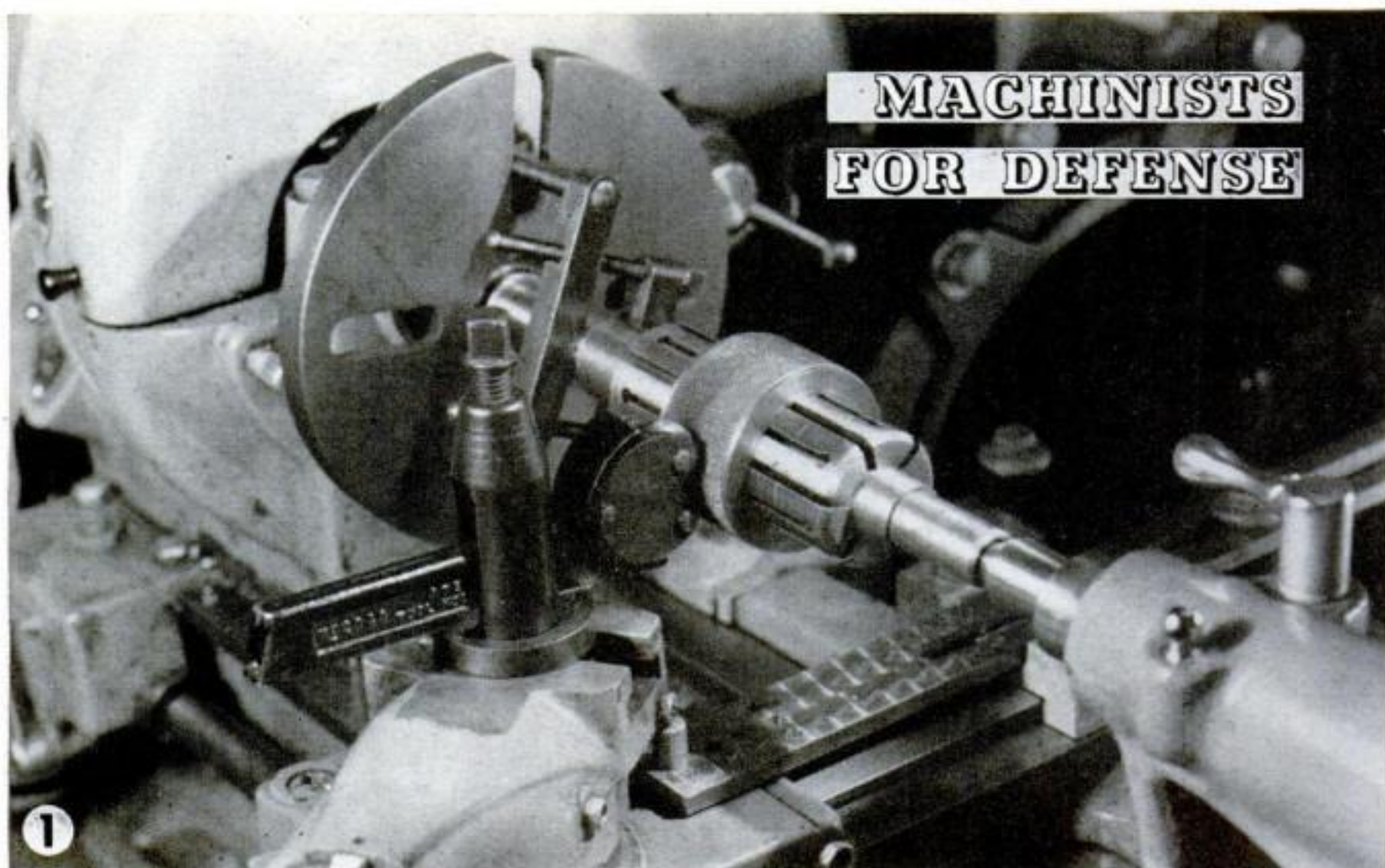
$1\frac{1}{8}$

$\frac{1}{4}$

$\frac{1}{4}$

$4\frac{1}{2}$





MACHINISTS FOR DEFENSE

Expanding Mandrel Holds

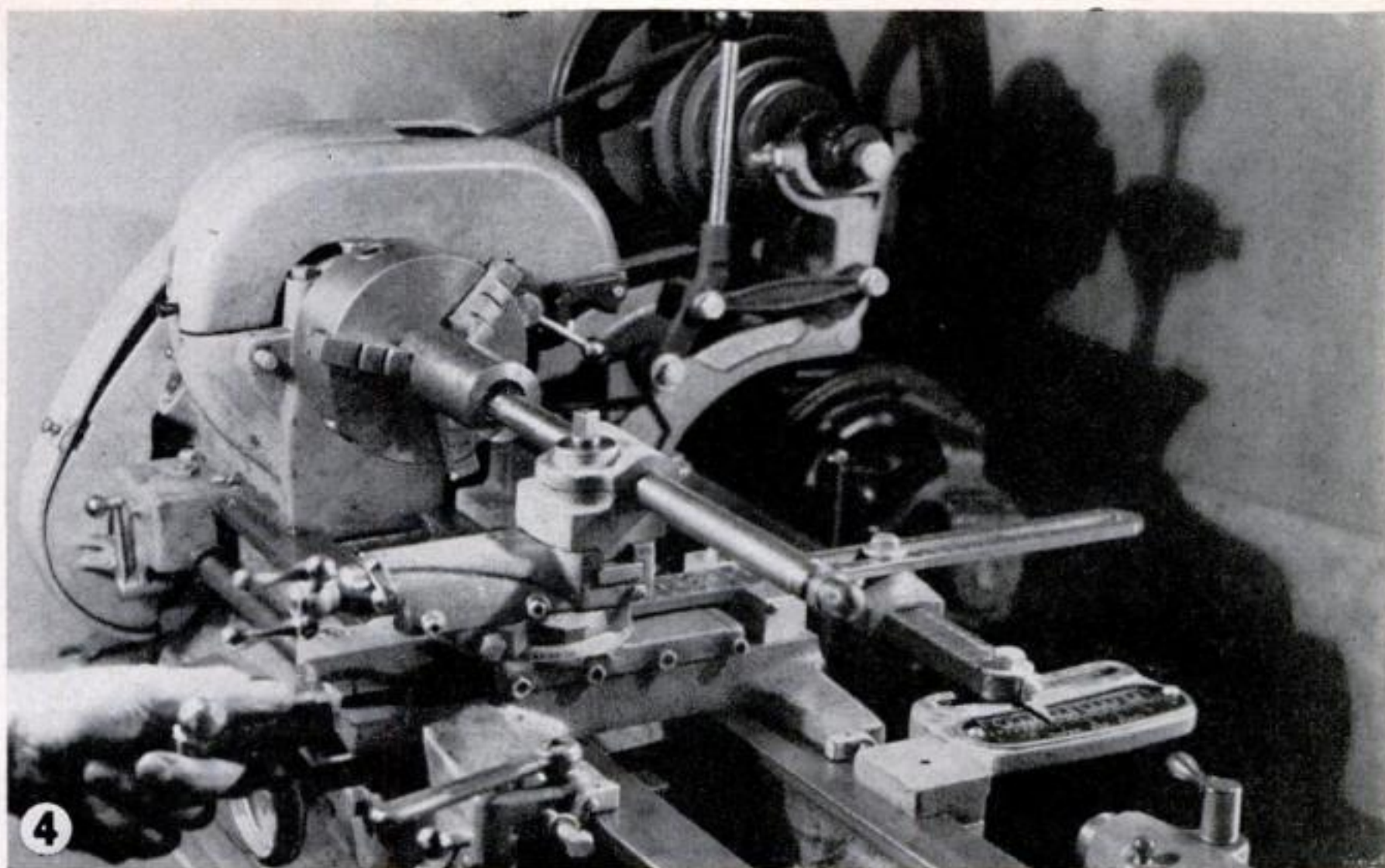


THE expanding mandrel shown in use in Fig. 1 consists of a tapered arbor and a split bushing taper-bored to fit it. This bushing is turned parallel on the outside, and expands evenly when the arbor is driven into it. Several bushings of different outside diameters may be used with the same arbor. For heavy duty, both parts should be of tool steel, hardened and spring-tempered. For occasional use, unhardened machine steel will serve.

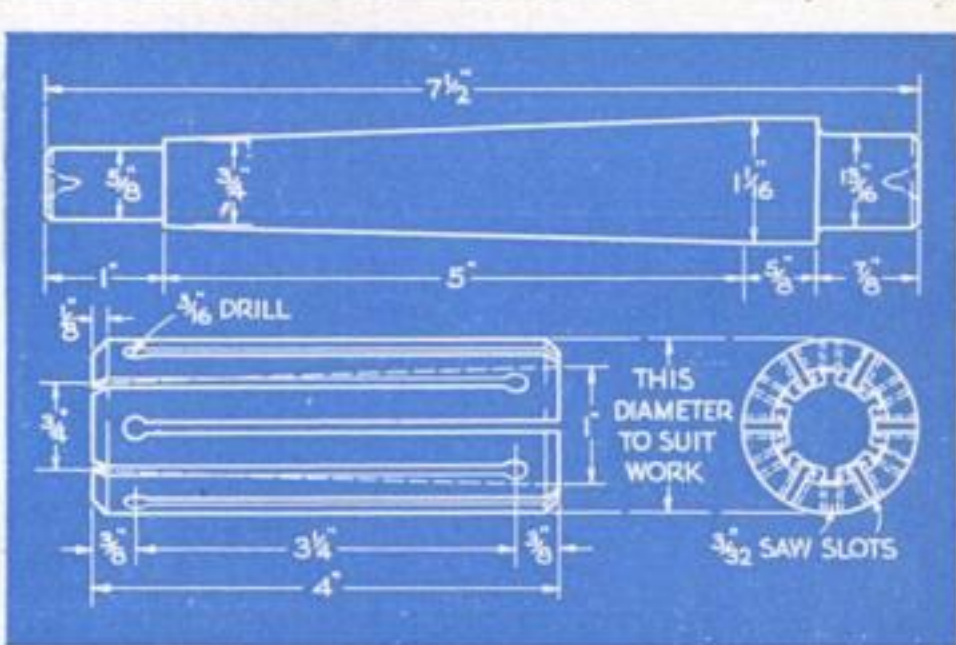
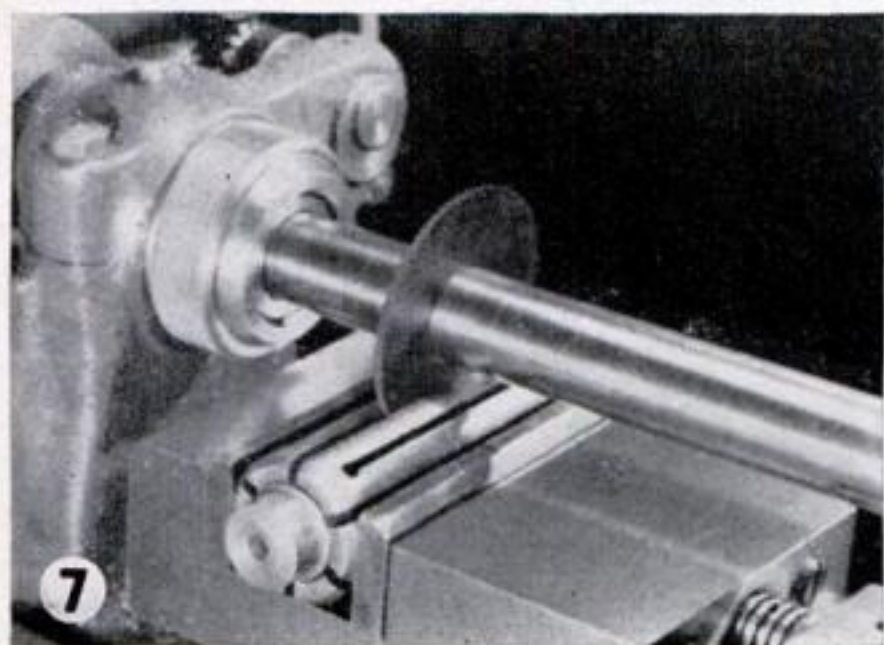
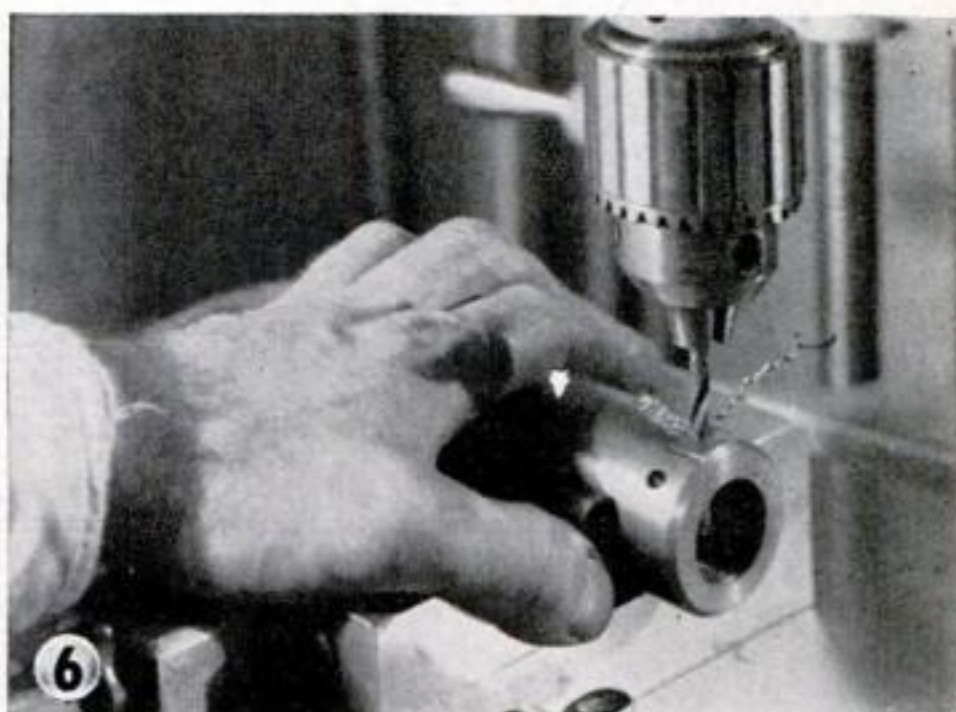
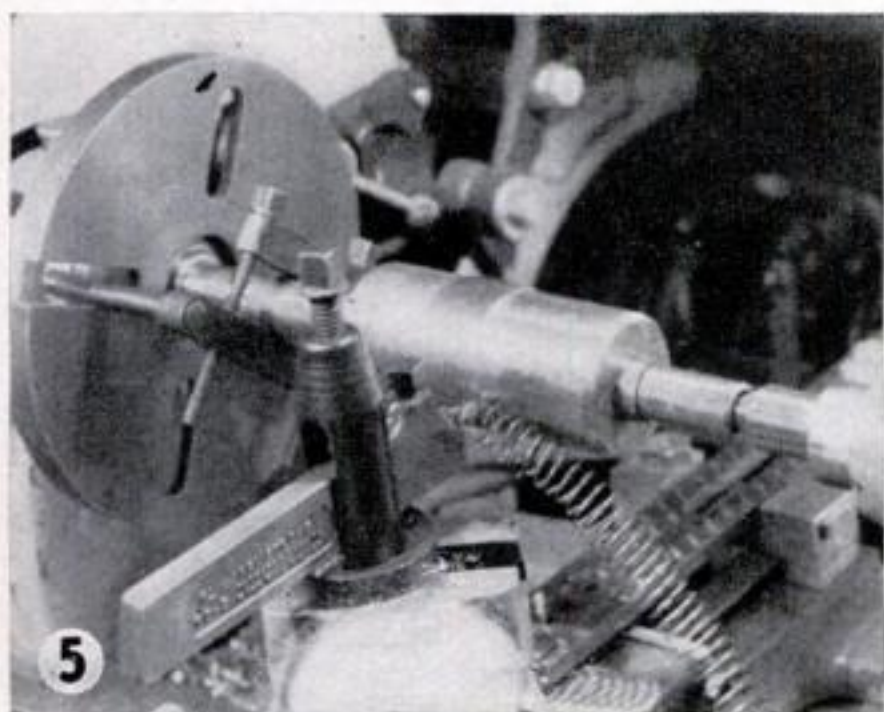
Centerdrill stock for the arbor carefully, and turn it as in Fig. 2 to the dimensions given in the drawings. To make the bushing, chuck a short steel bar and drill a $\frac{3}{4}$ " hole through it as in Fig. 3. Bore out the taper to match that of the arbor (Fig. 4).

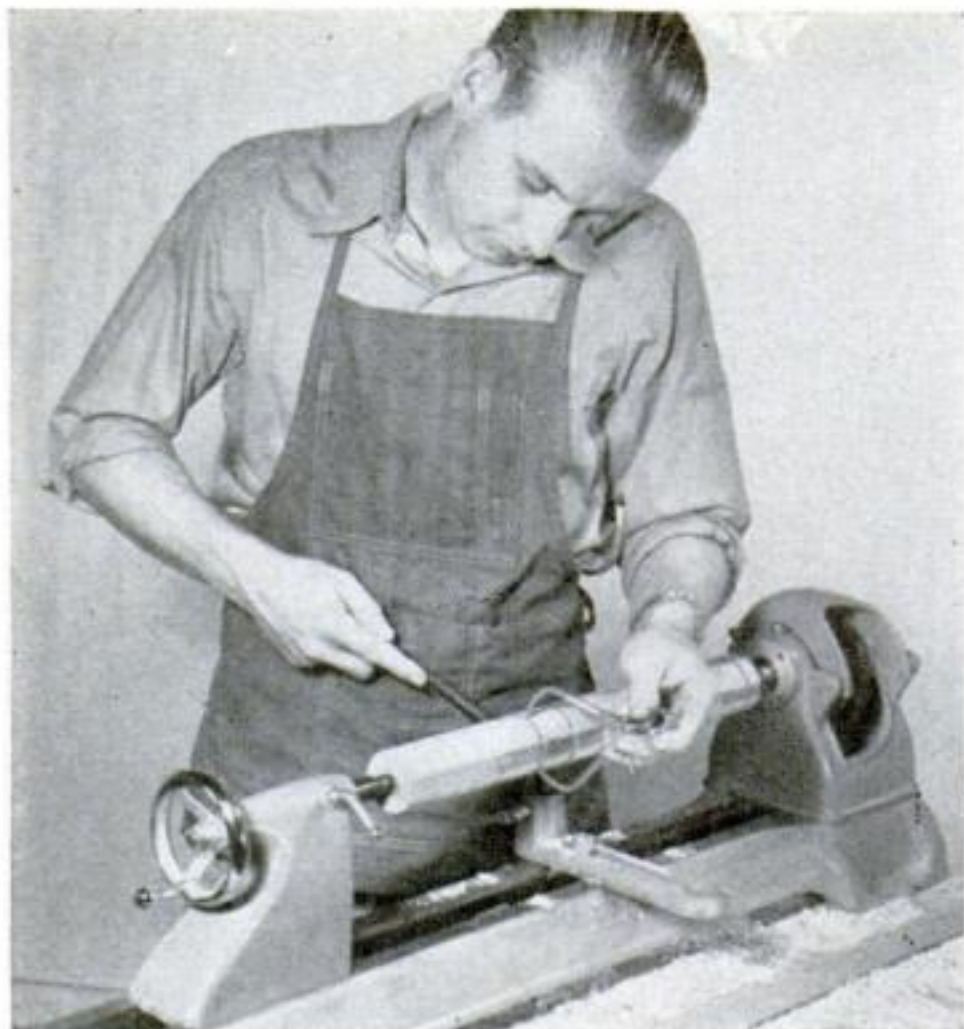
Drive the arbor into the bushing to turn the outside to size as in Fig. 5. Lay out six evenly spaced holes at each end of the bushing as in the drawing. Center-punch and drill these (Fig. 6).

The slots are easily cut with a milling attachment and cutter in the lathe (Fig. 7). A steel plug in the bushing holds it in shape during this operation. File smooth any rough edges.—C. W. WOODSON.

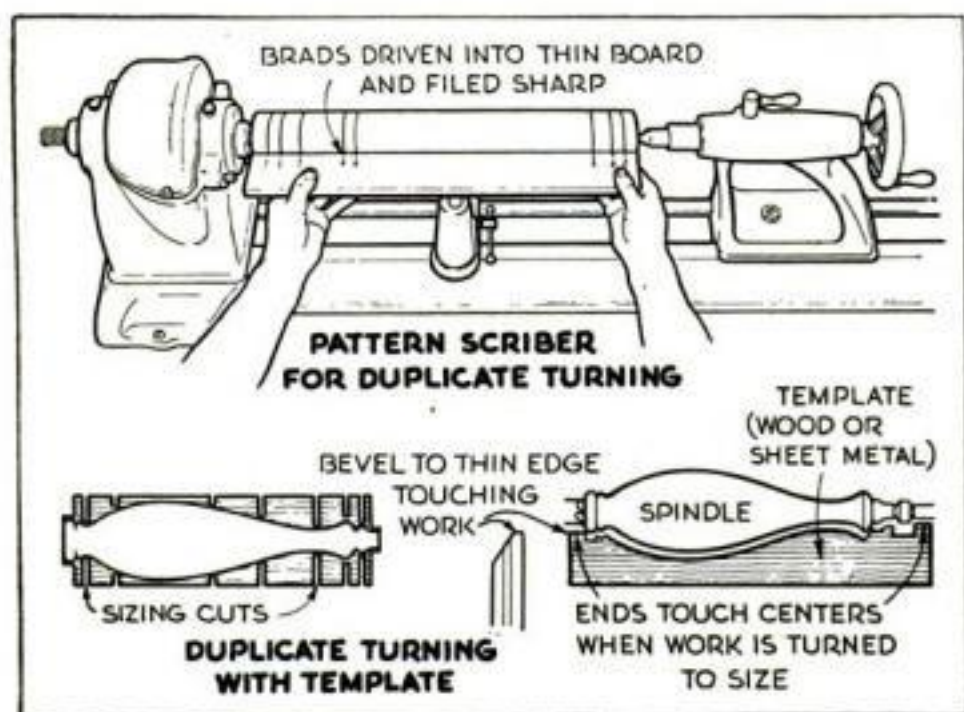


Bored Work Between Centers

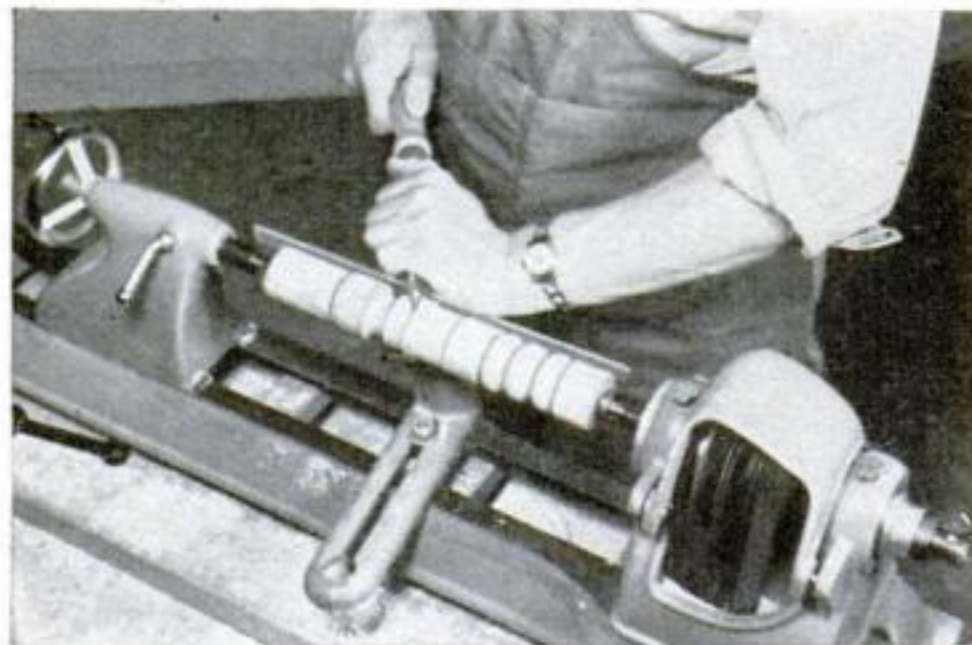




Sizing cuts at various points along a turning help in quickly roughing it to approximate shape and dimensions



Above, scribe and template as used in duplicate turning, and diagram showing sizing cuts. Below, turning a step. Skew is held as in the drawing on the facing page



Making

HOW TO DO SPLIT,

By Edwin M. Love

ONCE the basic wood-turning cuts have been learned, an entirely new field of accomplishment is open to the craftsman. He can at once apply his skill in this fascinating craft to the beautification of his own shop projects, and probably among the first things he will wish to turn out will be a set of legs for a table or other piece of furniture. As the operations in making such legs are equally applicable to almost all spindle turning, they are here described in detail, with a few time-saving short cuts and some methods of doing special work.

What are the steps in turning a table leg?

After roughing the work to cylindrical form, mark off the various beads, tapers, coves, and straight portions with a pencil while the piece revolves. With the parting tool, groove the work at these marks to the respective diameters by using calipers set slightly oversize. With a little practice, the calipers can be held against the work with one hand while the tool, in the other, brings the groove to depth. As the calipers spring open slightly and slip over revolving stock, they can be set almost to size and will nevertheless leave the work sufficiently oversize to permit of sanding it smooth.

Make several sizing cuts at various points along curved or tapering sections as guides in turning. Rough the work down to these cuts with a gouge. Turn thick parts to size first, thin ones last.

How are the various cuts and diameters connected?

Where a cove (concave profile) flows into a bead, turn the bead first, then the cove, carrying one side of the latter smoothly into the bead. On long reverse curves, the skew can be used to advantage. Start at the large diameters and work toward the smaller. Concave profiles are readily turned by rolling the tool slightly to cut into the

Furniture Legs on the Lathe

DUPLICATE, OFFSET, AND HOLLOW-CENTER TURNING

wood in the direction of the desired curve.

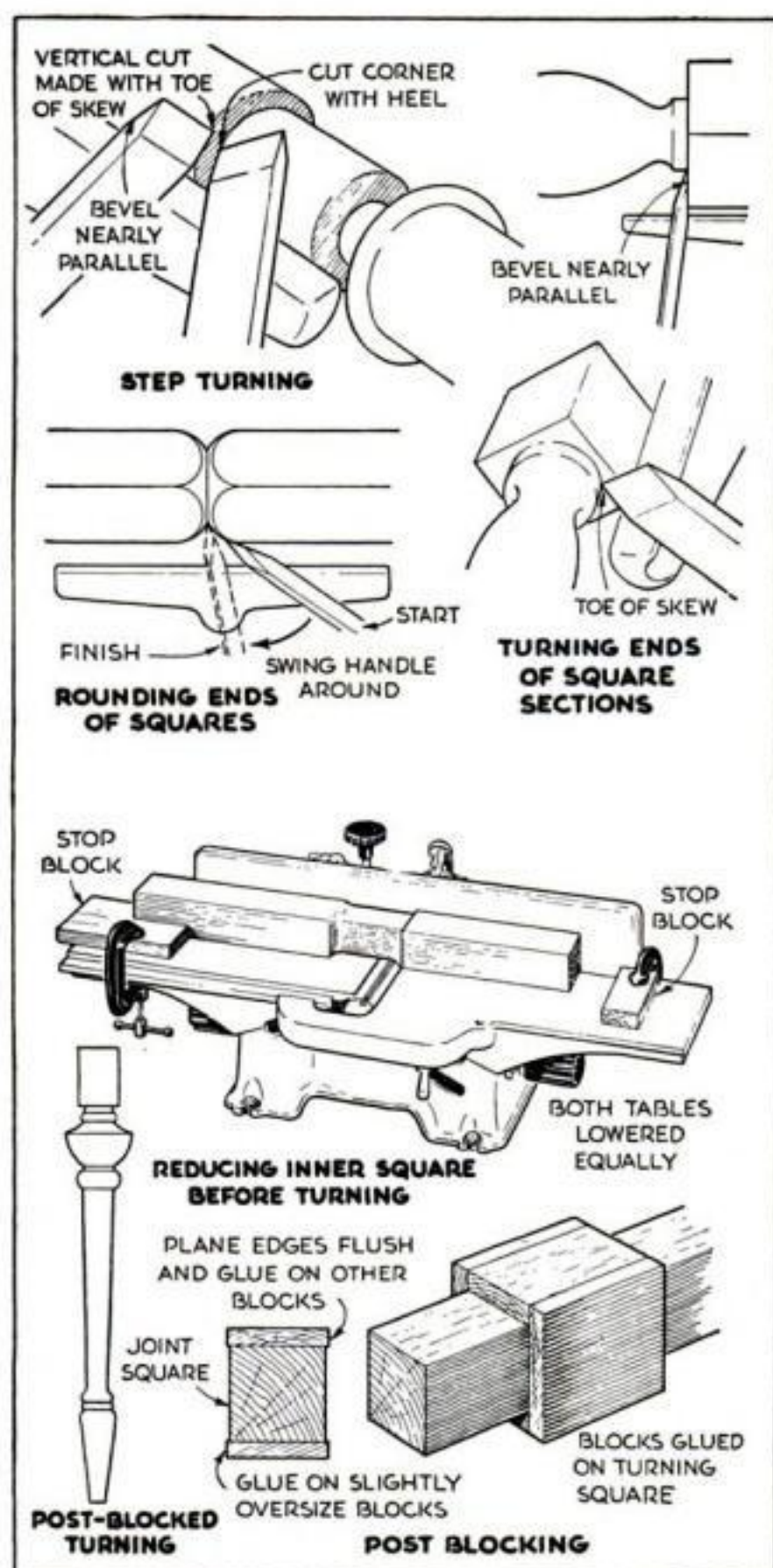
The vertical shoulders of stepped portions are turned with the toe of the skew, its bevel being held square with the axis of the work, almost parallel to the vertical cut. Use the heel to cut the flat part up to the shoulder, as shown in the drawings.

What is done to leave a square on a turned leg?

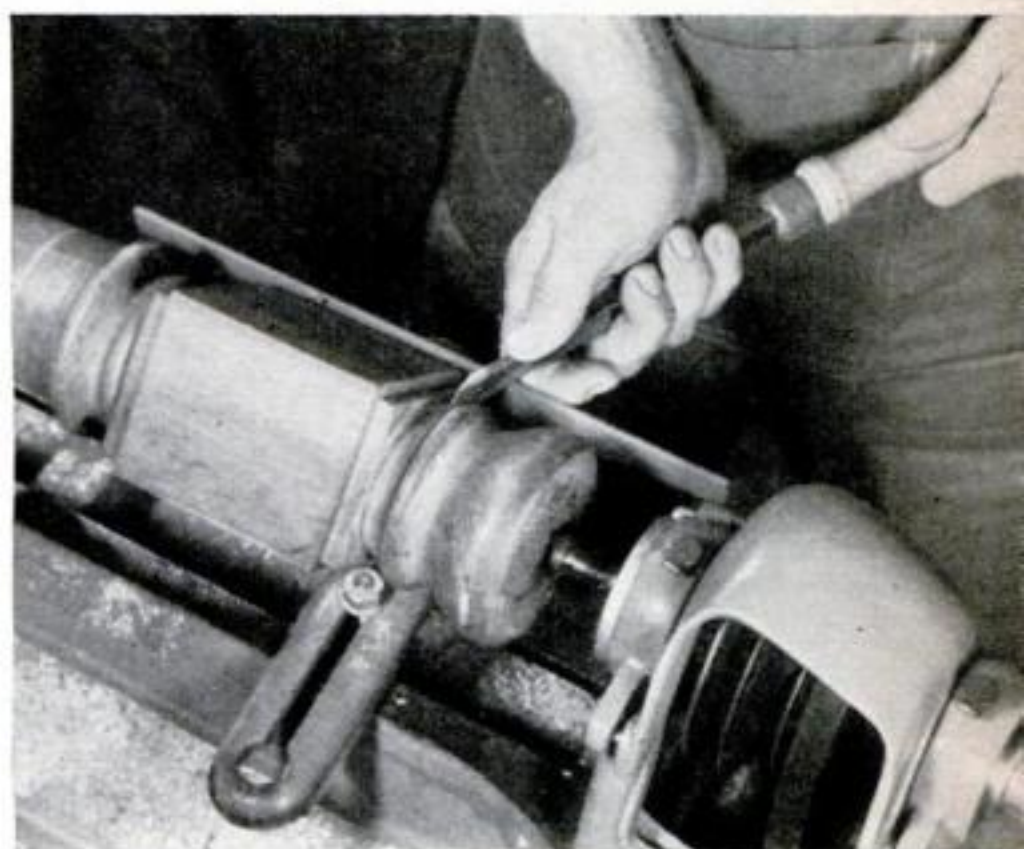
If one end is to be left square, simply be careful not to set the tool rest where it may

splinter the revolving edges, and keep the hands clear of this part of the work. Squares smaller than the turned portions should be cut to size before turning, either with a saw and chisel or on a jointer or band saw, if available. Clamp stop blocks to the table of the machine to limit the length of the reduced squares as required.

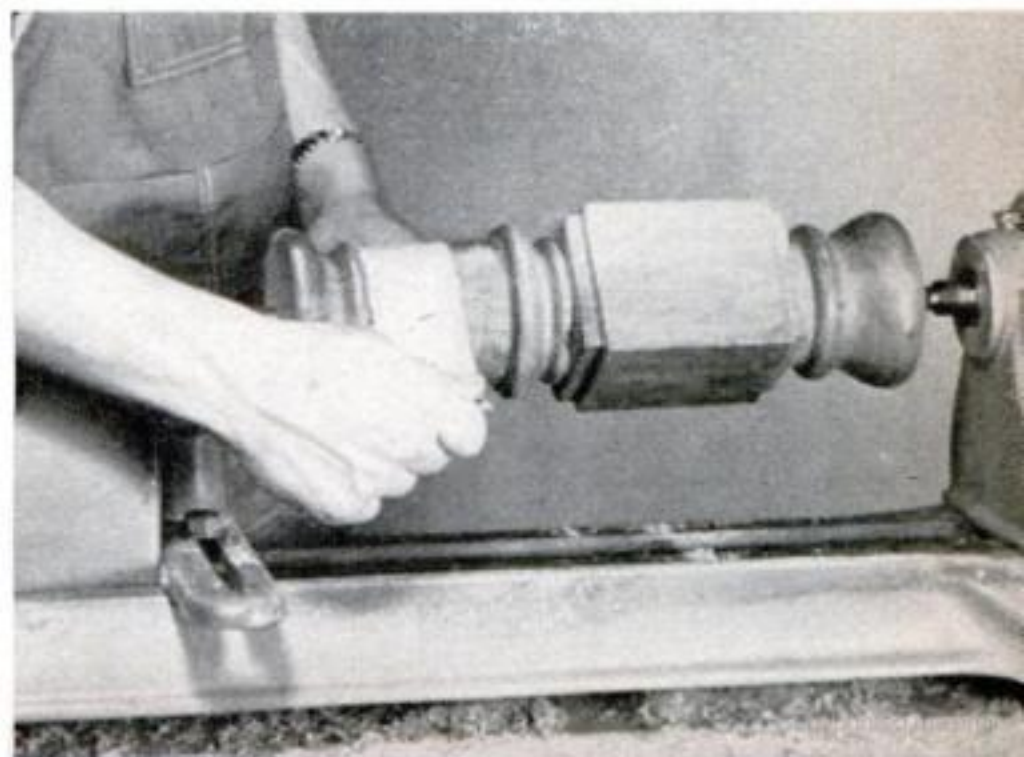
If the shoulder of a square section is to be rounded, use the point of the skew. Nick the corners and then swing the handle of the skew until it is at a right angle to the work axis, as illustrated. It is important in work

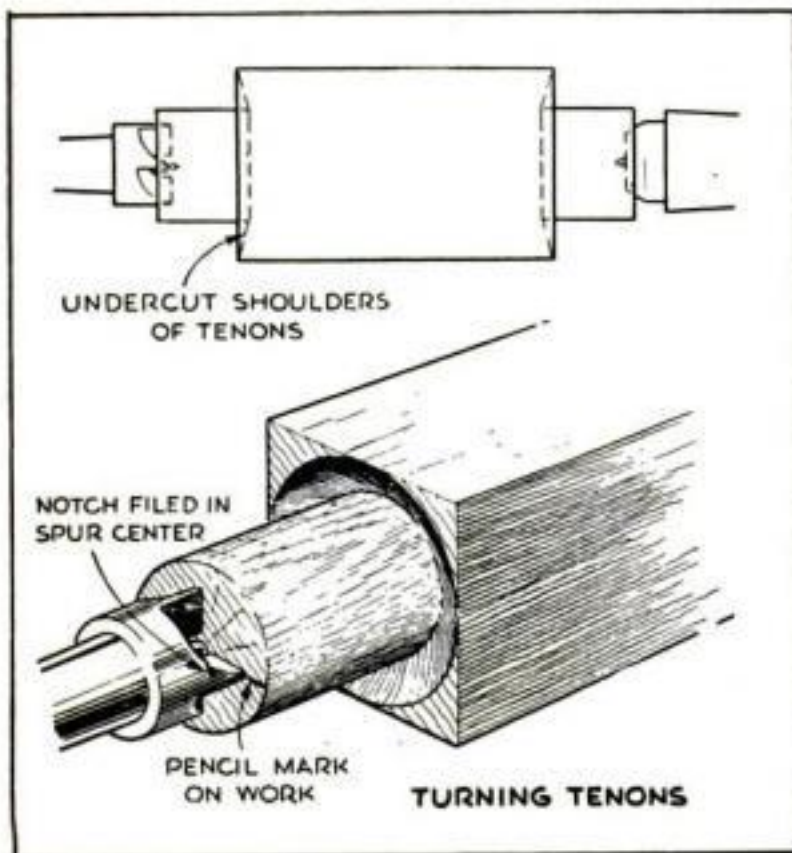


To turn the end of a square, use the toe of the skew as illustrated in the drawing at left. Keep hands well away from the revolving square section



Left, blocks on the jointer table limit length of a reduced square. Thick parts can be built up by post blocking. Below, using a strip of sandpaper to smooth a turning. Avoid rounding sharp edges





Marks facilitate replacing work in same position for further turning. Right, one hand supports a baton being smoothed with a block plane. Wear a glove if much of this is done



of this kind to take only light cuts to avoid splintering the edges.

How is a leg with a bulb center turned?

The alternative to using stock as heavy as the thickest portion of the finished piece is to glue blocks to the work wherever necessary to build it up to the required thickness.

How are tenons turned?

Tenons larger than the lathe centers can be turned like any cylinder. Undercut the shoulders slightly to insure a square, close fit against the mortised member. Such work can be taken off the centers and tried in the mortise, but be sure to file a notch in one spur of the live center and make a corresponding mark on the work, so that it can be replaced in exactly the same position for further turning if necessary. Tenons smaller than the lathe centers must be calipered to size, as the stock must be left big enough at the ends to find support on the centers.

Can springing of slender turnings be prevented?

Yes. Use a steady rest near the thin part, or a "backstick" consisting of a notched block clamped to the bed of the lathe.

How can a slender rod, such as a baton, be turned?

Support the work with the left hand, moving it along with the tool. For the smoothing

cuts, use a block plane held at an angle of approximately 45 deg.

Are special jigs needed for hollow-end turnings?

Only such as can be made on the lathe itself. Bore a hole of the required diameter in the end and turn a plug to fit. Mount this at the dead-center end. If both ends are bored, turn a plug on a small screw-center faceplate to hold the live-center end. To turn out work at one end, support it with a steady rest as near the end as possible.

What are split turnings?

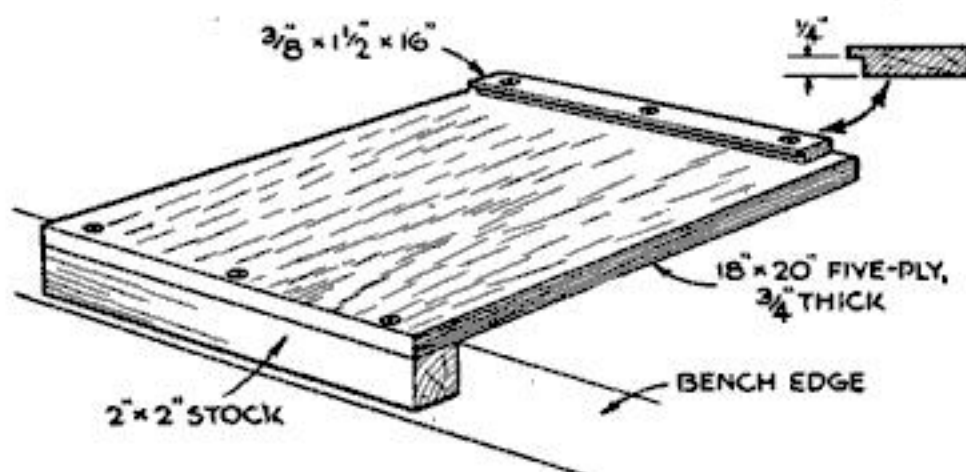
Semicircular turned sections, usually applied as ornaments. Since sawing a piece apart would reduce the size of both halves, split turnings are made by screwing together two pieces of wood to form a turning square. A better method for slender work is to glue the halves together with paper between. After turning, split them apart with a chisel.

Is oval turning possible?

A close approximation is achieved by offset turning. Use rectangular stock, draw center lines on the ends, and lay out the oval desired. Then locate off-centers on opposite sides of the true center and draw the ridge lines on the narrow sides of the stock. Mount the piece on the lathe off center and turn to the ridge lines on one side; then shift to the other off center and turn the other side, stopping often to gauge the work, since

BENCH HOOK FOR PLANING THIN STOCK [WOODWORKING]

THIS bench hook offers a firm base for planing thin pieces of wood, which are otherwise difficult to hold. It consists of a five-ply piece having a lug screwed on one end to catch against the bench, and a rabbeted hardwood cleat at the other end, on top. To plane stock $\frac{1}{2}$ " thick or thicker, rest it directly on the plywood base; for $\frac{3}{8}$ " or thinner material, lay a sheet



of $\frac{1}{4}$ " plywood on the base, hooking the end under the stop to prevent it from lifting while the planing is being done.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

calipers cannot be used. Finally, use the true centers to turn off the ridges, sandpaper while the work revolves, and finish sanding by hand parallel to the grain.

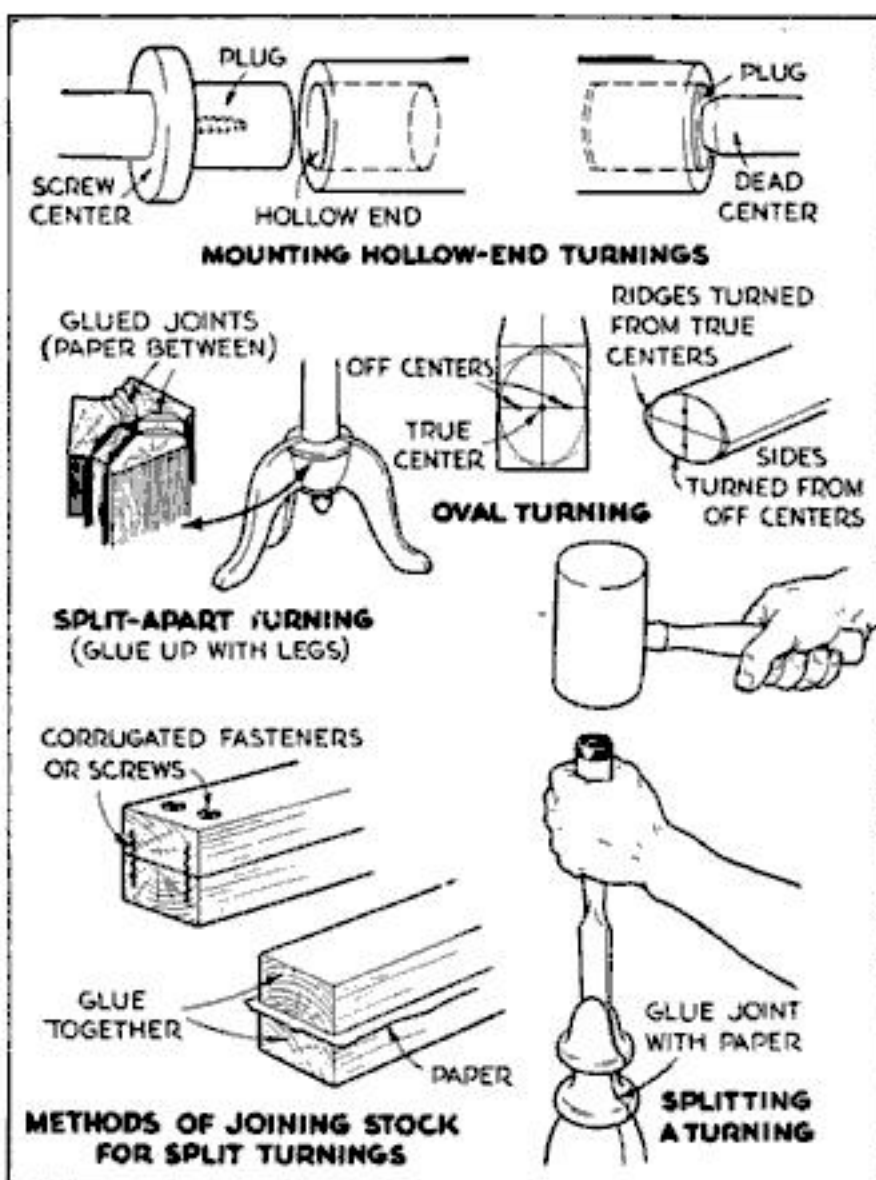
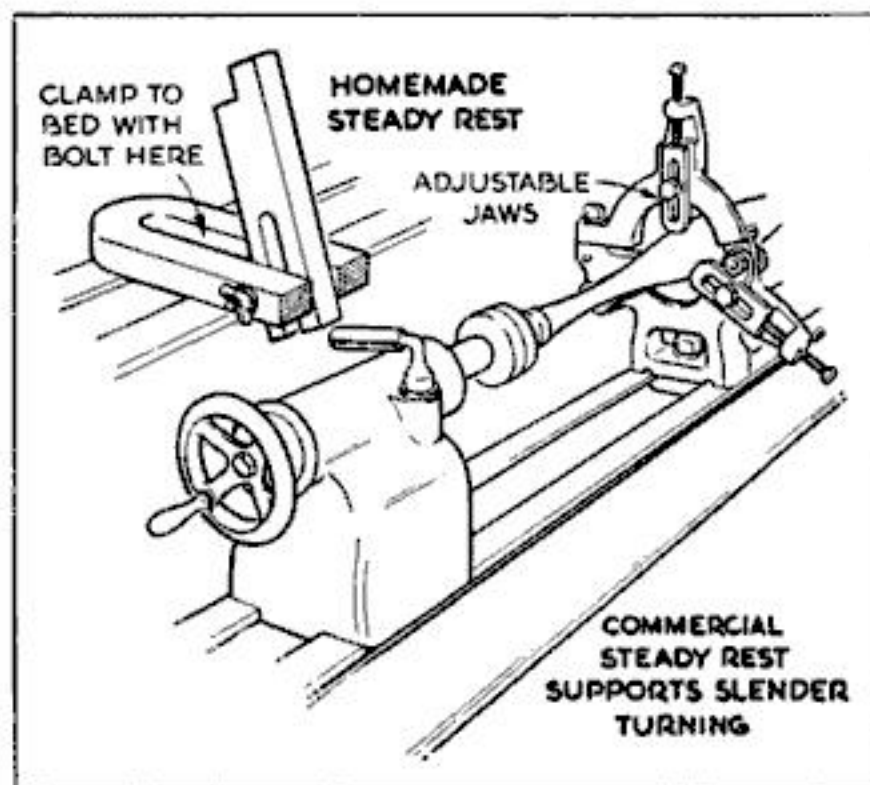
How is sanding done in the lathe?

Remove the tool rest and use a strip of sandpaper, as shown in one of the photo-

graphs, or a folded pad held against the work from the back, where the hand will be thrown up, rather than down against the lathe bed, if the paper should catch. Too high a speed will scorch the work. Use No. 0 or 00 sandpaper for finishing, moving it back and forth to prevent scratching. It pays to sand fine hardwood lengthwise of the turning after stopping the lathe.

At right, how stock is prepared for hollow-end, oval, and split turning. Paper between the glued joints makes it possible to split them apart with a chisel after the lathe work has been completed

Below, a commercial steady rest in position for supporting long or thin work. The simple homemade backstick shown serves somewhat the same purpose



Typewriter Desk for Home Use

DESIGNED BY JOSEPH ARONSON

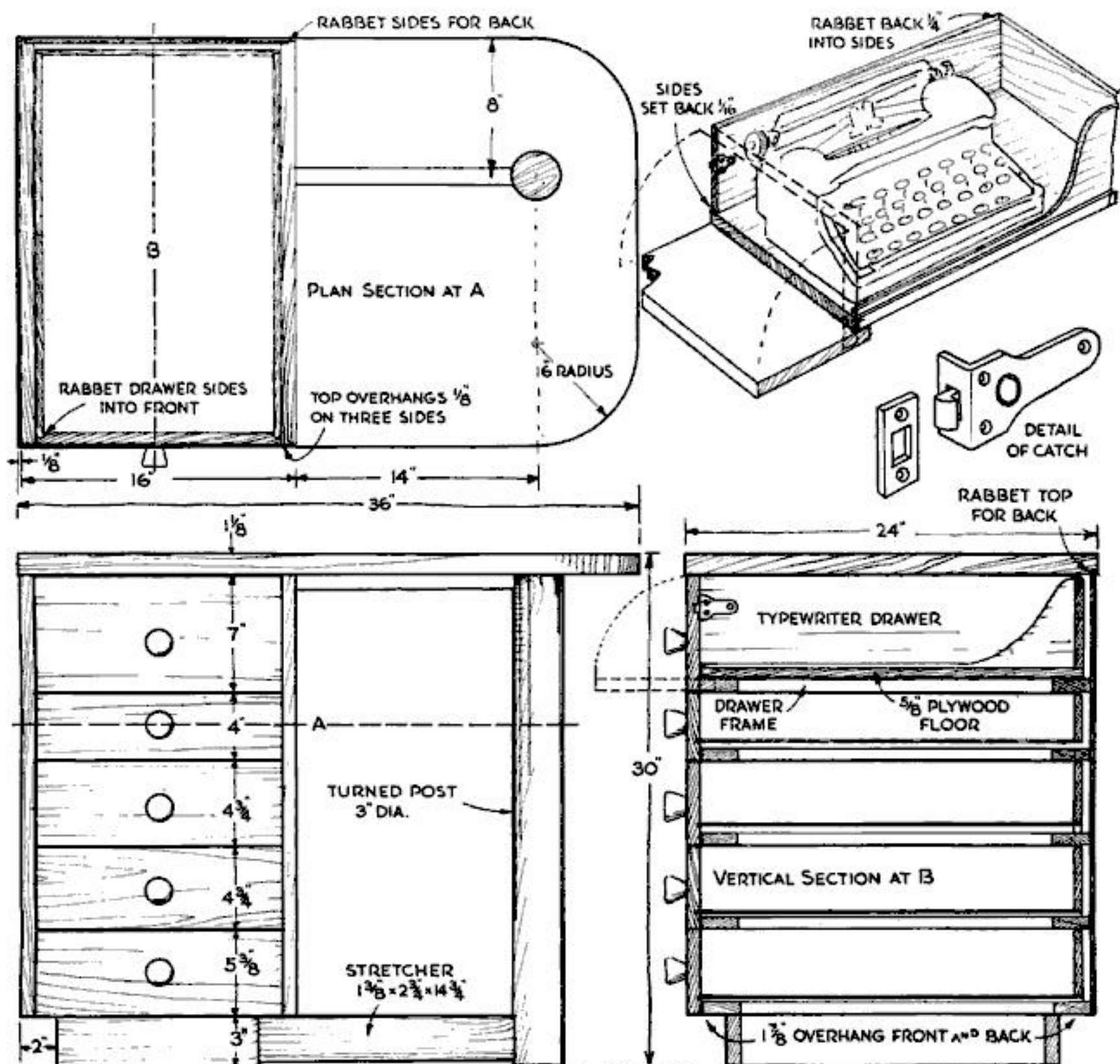
HERE is a compact modern desk that has a special drawer for a small typewriter. Although designed for a living room, library, study, or student's bedroom, the desk, if made with a 36" top as shown, would also be suitable for a modern housekeeper in a roomy, up-to-date kitchen. For other purposes, where space permits, the length may be 48". In some cases, too, it might be desirable to place the drawer case on the right. Be sure that the typewriter compartment is big enough for the machine it is to hold.

Cut a $\frac{1}{4}$ " deep blind dado at the rear edge of the top to receive the plywood back. Glue up the drawer frames with a dowel at each corner to join them to the sides of the case. Assemble with glue along the edges

of the frames as well as at the joints. Glue and screw the base to the bottom frame.

The upper stretcher is screwed to the top, but doweled to the inner side of the drawer case and the turned post. The post is also doweled to the top. Both stretchers are shaped with files, a gouge, or on a sanding drum to the curve of the post. Dowel the bottom one to the post and screw it fast to both drawer frame and base.

One side of the typewriter drawer is cut down for the greater part of its length. The other must be a close sliding fit to prevent sagging. Assemble the drawer around a $\frac{5}{8}$ " plywood bottom with dowel or rabbet joints. Attach the front with 2" narrow butt hinges. A block may be screwed to the





bottom for a stop. If a regular desk-drawer catch cannot be obtained for the hinged front, use a cupboard elbow catch. It is advisable to fasten the typewriter down.

The other drawer bottoms are set in grooves in the front and sides, but are carried under the backs.

The desk may be stained and varnished, given a modern bleached finish, or enameled. Colored artificial leather may be fastened to the top with gilt or chrome tacks.

LIST OF MATERIALS

No. Pc.	Description	T.	W.	L.
1	Top	1 1/8	24	36
2	Sides	13/16	23 3/4	25 7/8
1	Back (plywood)	1/4	15	26 1/8
2	Bases (mitered)	13/16	3	20
2	Bases "	13/16	3	12
1	Top stretcher	7/8	2 3/4	12 7/8
1	Bottom stretcher	1 3/8	2 3/4	14 3/4
1	Turned post	3	—	28 7/8
10	Frame sides	1/2	2	18 11/16
10	Frame rails	1/2	2	14 3/8
1	Drawer front	13/16	7	14 3/8
1	" "	13/16	4	14 3/8
2	Drawer fronts	13/16	4 3/4	14 3/8
1	Drawer front	13/16	5 3/8	14 3/8
1	Top-drawer bot.	5/8	14 1/4	22 3/16
2	Top-drawer sides	1/2	5 7/8	22 3/16
2	Drawer sides	1/2	3 1/2	22 7/16
4	" "	1/2	4 1/4	22 7/16
2	" "	1/2	4 7/8	22 7/16
1	Drawer back	1/2	5 7/8	13 3/4
1	" "	1/2	3	14
2	Drawer backs	1/2	3 3/4	14
1	Drawer back	1/2	4 3/8	14
4	Bottoms (ply.)	1/4	13 7/8	22 7/16

Miscellaneous: Five drawer knobs, two 2" by 2" narrow butts, one desk-drawer or elbow catch.

Note: All dimensions are given in inches and are finished sizes.

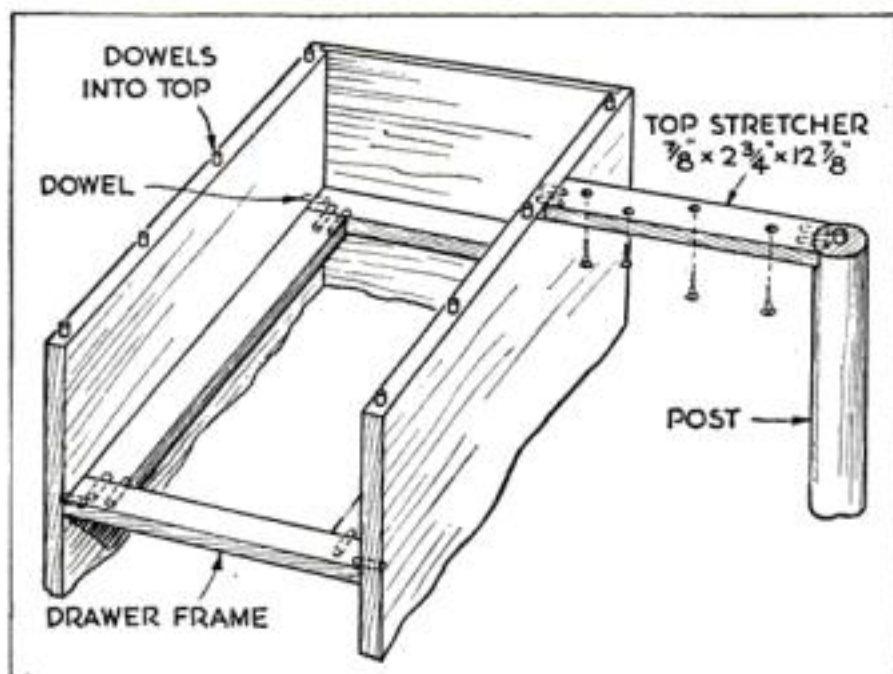


Table Lamps in Wood

SEVEN NEW DESIGNS BY JOSEPH ARONSON, INTERIOR DECORATOR

THE current trend in interior decorating is toward tall, large-scale table lamps in preference to floor units. As even big lamps require comparatively little material, and as waste from larger projects can often be utilized in making such pieces, they are well worth the craftsman's time. The finished articles often have excellent sales possibilities and bring good prices.

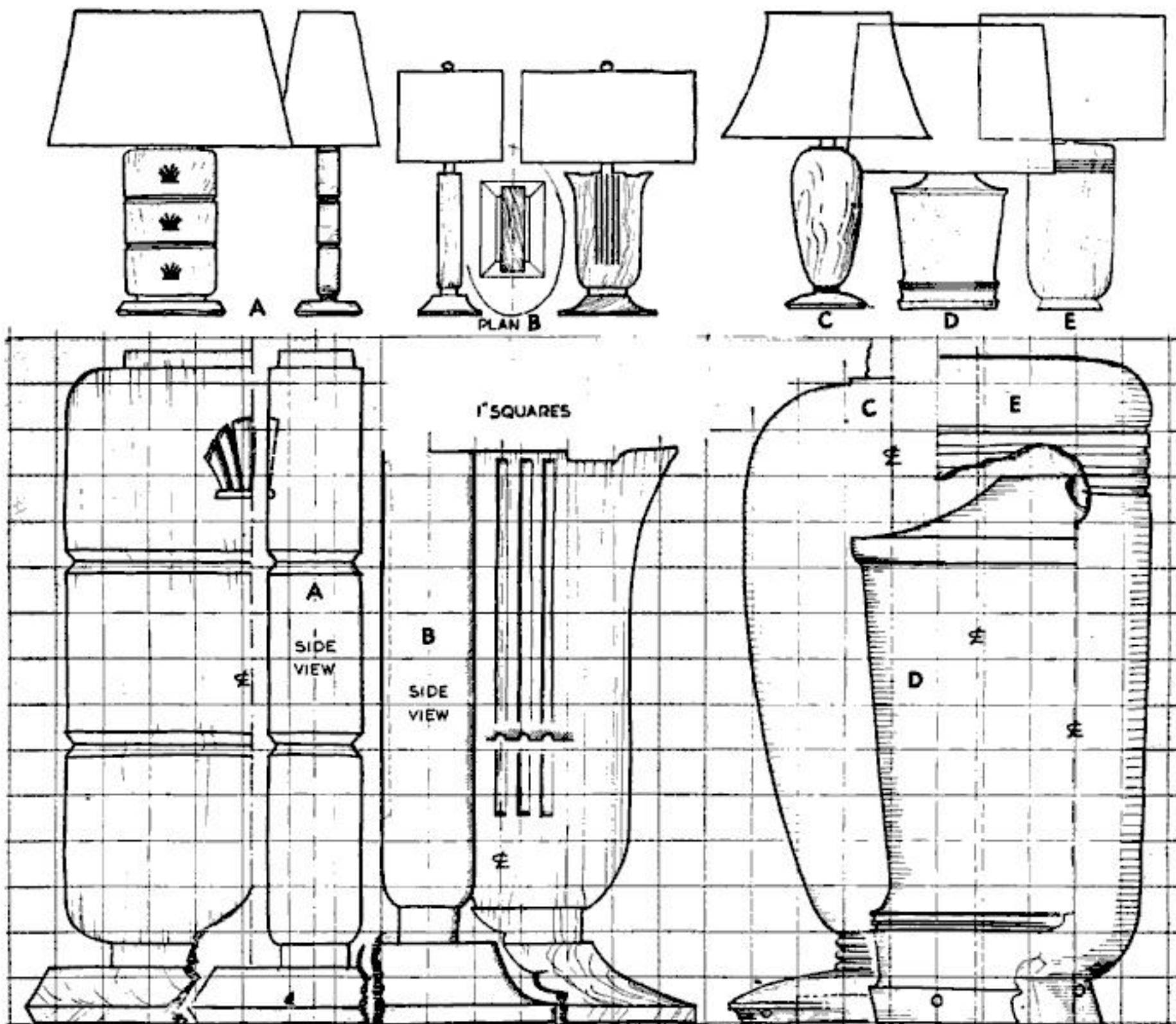
All dimensions of the lamps illustrated are evident by comparison with the 1" squares on which they were drawn. If smaller lamps are wanted, it is necessary only to draw the patterns or profiles on $\frac{7}{8}$ ", $\frac{3}{4}$ ", $\frac{5}{8}$ ", or even $\frac{1}{2}$ " squares to scale them down accurately. The shades should, however, be of such sizes as to maintain more or less the same propor-

tions as those in the accompanying sketches.

Very handsome lamps can be made from applewood, fir, pine, maple, ash, walnut, and other woods. If the stock has checks or cracks, they may be filled with plastic composition wood.

The flat-cut designs A and B are easy to make and do not require exceptionally thick stock. If you must glue up two thicknesses for these, be sure to rout or saw out a channel in the middle of each inside face first. This will save you the trouble of drilling a hole for the pipe and cord. The transverse V-cuts on A can be made on the circular saw with the table tilted. The simple shell motif can be carved easily with a round chisel. Then the lamp is sanded smooth.

ILLUSTRATED WITH FREEHAND SKETCHES BY THE DESIGNER



On *B*, the long grooves can be formed by making two or three parallel cuts on the circular saw for each, and finishing with a small gouge or round chisel and sandpaper. This is an especially suitable lamp for rooms furnished in the Federal style, particularly if it is finished in mahogany or gray-white enamel.

Turned designs *C*, *D*, and *E* should be made from solid stock if they are to show grain when finished; if not, they can be turned from glued-up pieces. If the throw of your lathe is too small to turn the size lamp desired, you can band-saw these profiles to make square or even octagonal columns instead of turned ones.

Conventional shellac, varnish, or pickled finishes may be used if the stock has a pleasing grain. Where an opaque finish is preferred, gold, aluminum, and copper leaf, as well as japan colors and enamels, may be considered.

Probably the square designs *F* and *G* are

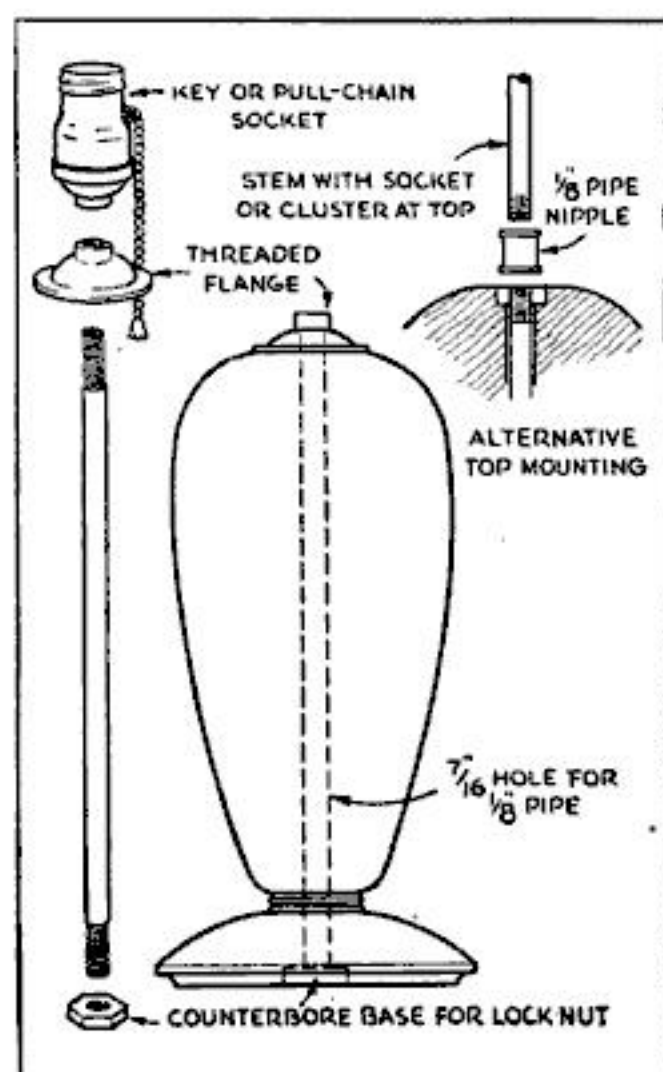
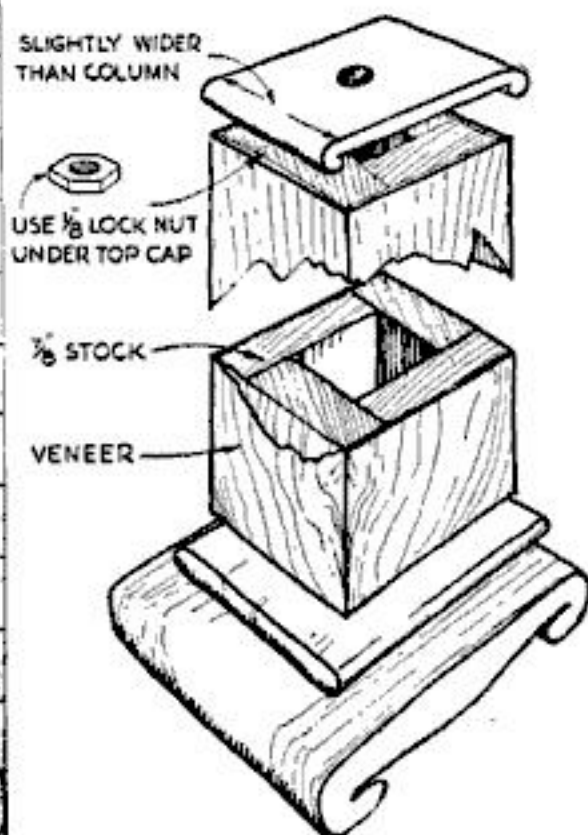
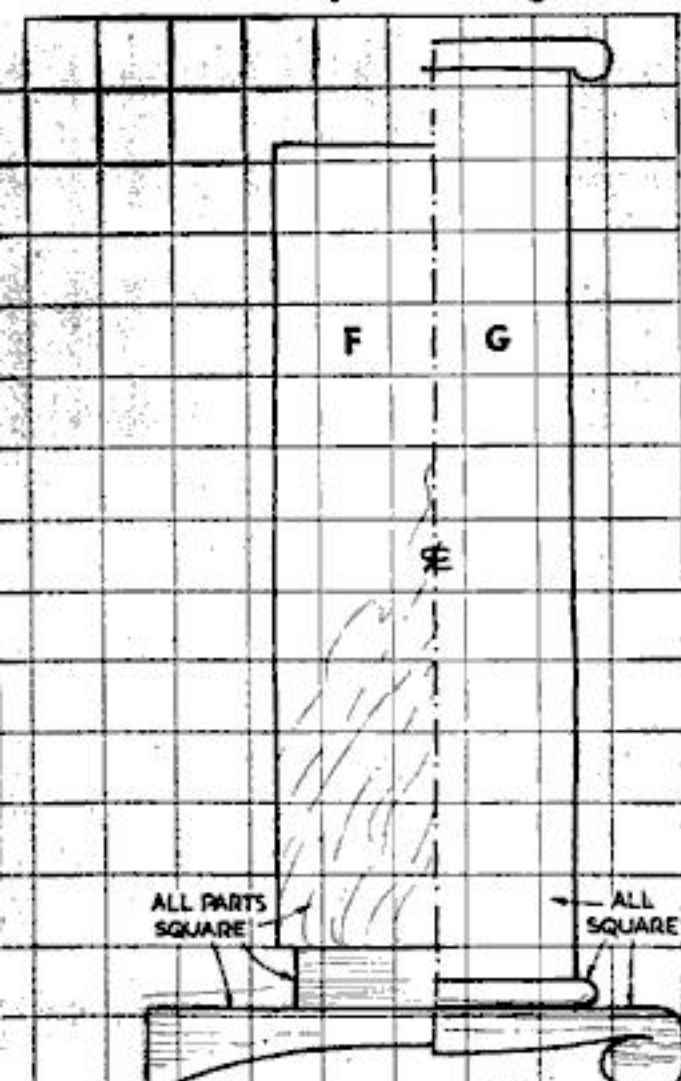
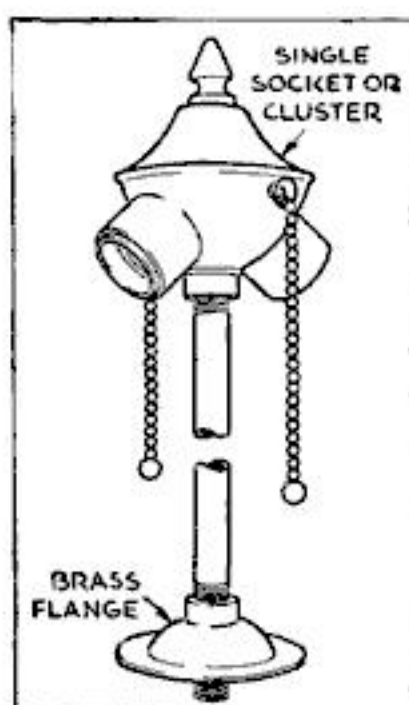
simplest to build. The columns may be solid, in which case a hole must be bored through them for the cord, or they may be built up as shown from four pieces in the form of hollow squares. In the latter case they must be finished in opaque metal leaf, enamel, or lacquer, or else veneered. Apply veneer to opposite faces at the same time, letting it extend well beyond the edges. When the glue has set, trim the material flush before veneering the other two faces. The final trimming of these must be very carefully done.

If you wish to use scraps of fine cabinet woods, without veneering, build the hollow columns with mitered corners to present four perfectly smooth sides for finishing.

The base and cap of design *G* are band-sawed from heavy stock, or else sawed from thinner stock and glued up to the requisite thickness if necessary, and smoothed on a sander. The fixture may be mounted with a brass flange and lock nut directly on the cap

if the latter is securely glued to the column, or run a $\frac{1}{8}$ " pipe (about $\frac{3}{8}$ " outside) through as shown in the diagram and secure with a lock nut at the bottom. There is ample clearance for the lamp cord to be taken out under the base of *F* or *G*, so no holes need be drilled in this part.

Assembly details below are for lamps on the facing page; left below, those for the square lamps; and directly at left, fitting for more than one bulb



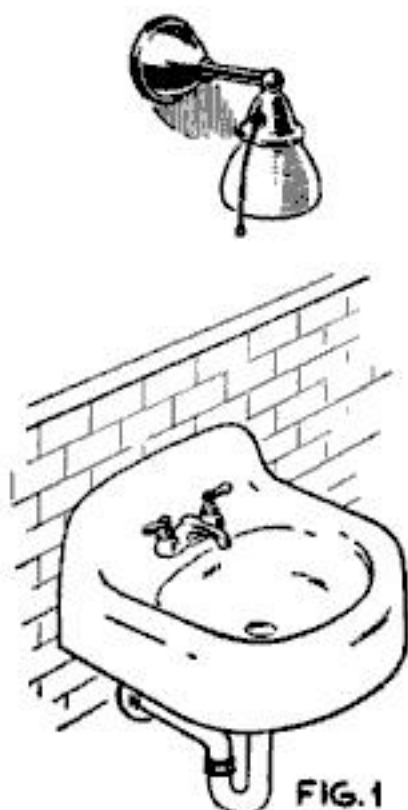


FIG. 1

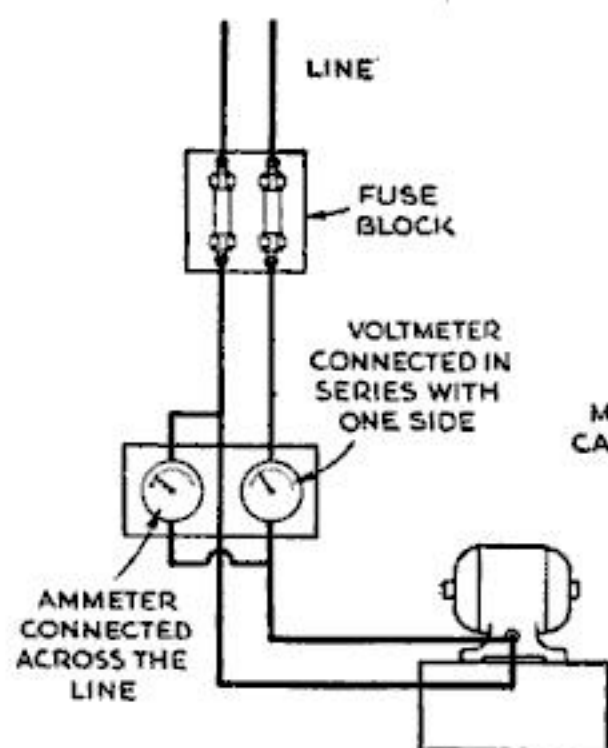


FIG. 2

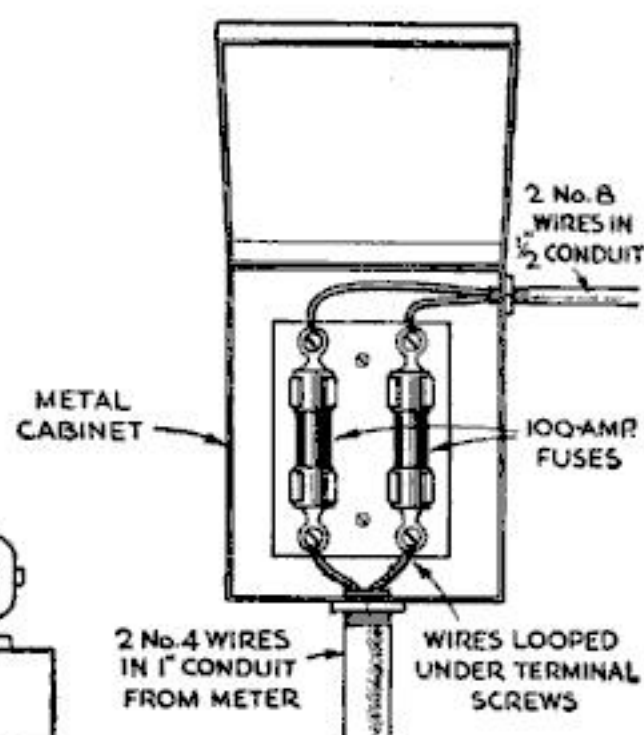


FIG. 3

What's Wrong? TEN ELECTRICAL ERRORS FOR YOU TO DISCOVER

WHAT is wrong in Fig. 1? It shows a brass-bracket electrical fixture over a washbasin in an old house where the wiring is of the knob-and-tube or open type. In Fig. 2 is a hook-up used to measure the voltage and amperage on a motor circuit. Open wiring has been shown for clarity. See if you can spot three errors. Fig. 3 shows a submain fuse block installed to supply power to a home workshop, and there are six mistakes. To check your answers, turn the page upside down and read the following:

1. It is never a good plan to place a metal fixture over a washbasin, sink, or tub, especially when wiring is nonmetallic so fixture is not grounded. If the fixture is touched with wet hands, a shock may be sustained. A special insulator on the head chain of the socket would help prevent this, and is required by the Electrical Code. 2. (a) A voltmeter is always connected across the line. (b) An ammeter is always connected in series with one line. In the case illustrated, the ammeter would burn out or cause a short circuit and blow the fuses. (c) No starting switch is connected in the circuit so it would be impossible to stop the motor without pulling the fuses. 3. (a) A submain as heavy as No. 4 would not be likely for a home workshop supply. The No. 8 would run through from cut-out to the meter. (b) No bushings are shown on the inside end of either conduit. (c) The fuses are too large. No. 8 wire, in general, should be fused at not over 35 amperes. (d) Fuses of 100 amperes are the knife-blade type rather than the ferrule-

clip type shown. (e) Wires are in wrong sizes of conduit. The two No. 4's should be in 1 1/2 inch pipe, the two No. 8's in 3/4 inch. (f) Wires larger than No. 8 cannot be connected under terminal screws unless terminal lugs or pressure connectors are used.

Added Foot Switch Simplifies Use of Three-Way Floor Lamp

THREE-WAY floor lamps are usually burned at the same level of illumination each time, yet whenever the switch is operated it must be turned through the other two points as well. If, in addition, the lamp has three candelabra lights, care must be taken not to confuse the two switches. To avoid this trouble it is possible in a good many cases, depending upon the design of the lamp, to install a canopy push-switch in the lamp base for turning the entire lamp on and off with a touch of the foot.

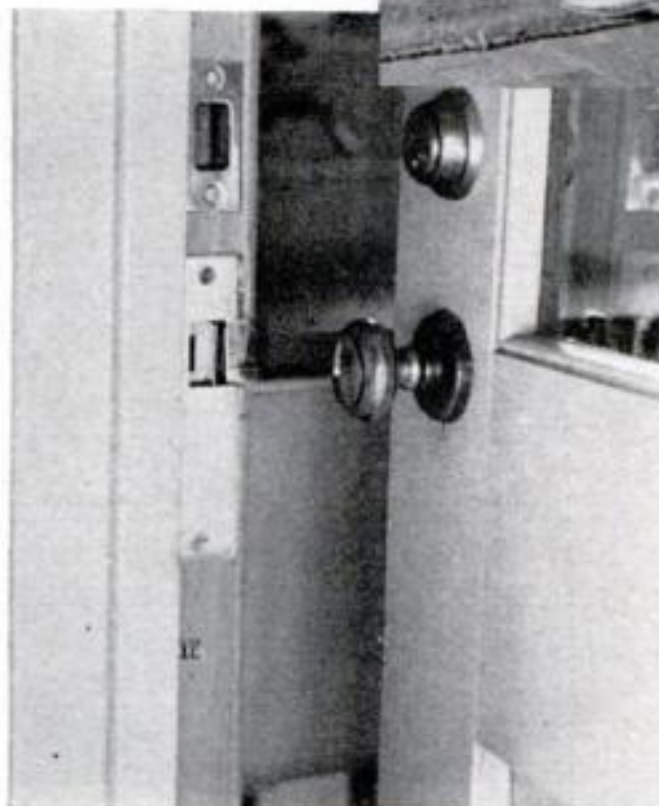
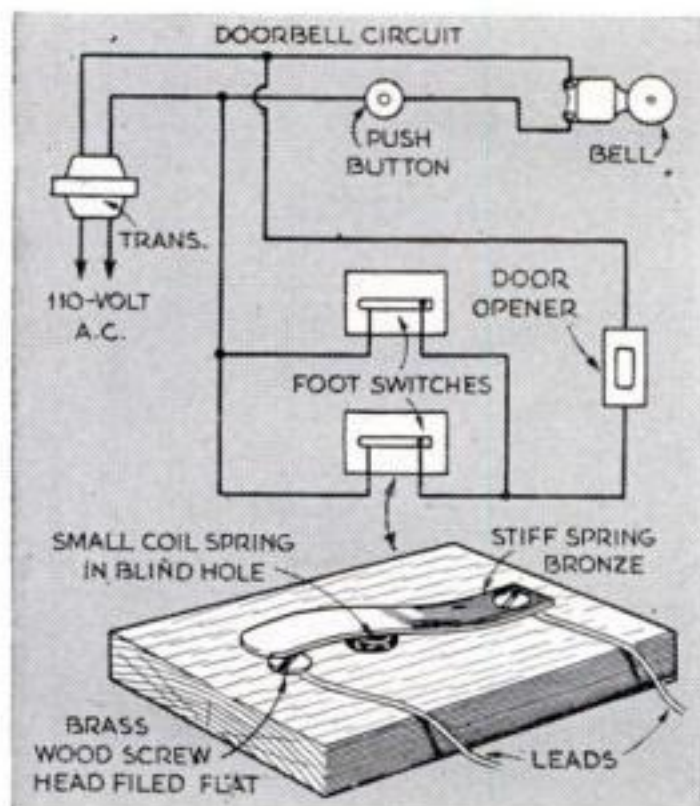
Here is another tip worth remembering: If you use long extension cords for trouble lamps or other purposes, get one of the small reels on which such cord is shipped by the manufacturer. Electrical supply dealers usually have empty ones on hand. The exact middle of the extension cord should be fastened to the spindle of the spool, and the cord is then wound on double. In this way it becomes necessary to unwind only the length of the cord needed; the remainder simply stays on the spool.

Electric Door Opener

OPERATES BY CONCEALED FOOT SWITCH

THIS simple device opens a door at the touch of a foot switch and leaves the hands free for carrying trays between the kitchen and the porch or dining room. Such a door release may be equally useful in a busy office, stockroom, or shop.

The strike or latch plate is removed and replaced with a standard electric door opener such as used in apartment houses. A low-priced spring door check is reversed on its bracket and installed so that it will push the door open when the catch is released. To provide an extra initial push, a small spiral spring is fitted into a hole in the jamb, as shown in the photograph below. Connect the electric latch to the doorbell transformer in series with two simple foot switches, one on each side of the door.—R. B. LEWIS.

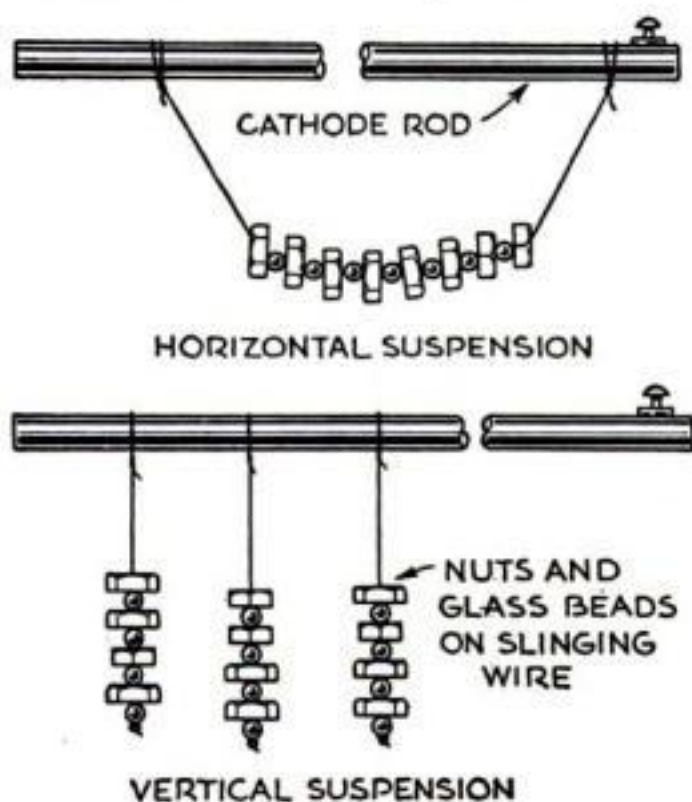


Trays and other awkward loads can easily be carried through a door fitted with an automatic opener that is operated by a switch under the mat

A standard electric door opener is installed in the door jamb. A small coil spring (near bottom of photo) gives the door its initial push. Left, wiring diagram and sketch of switch

ELECTROPLATING, PART 9

[ELECTRICAL]



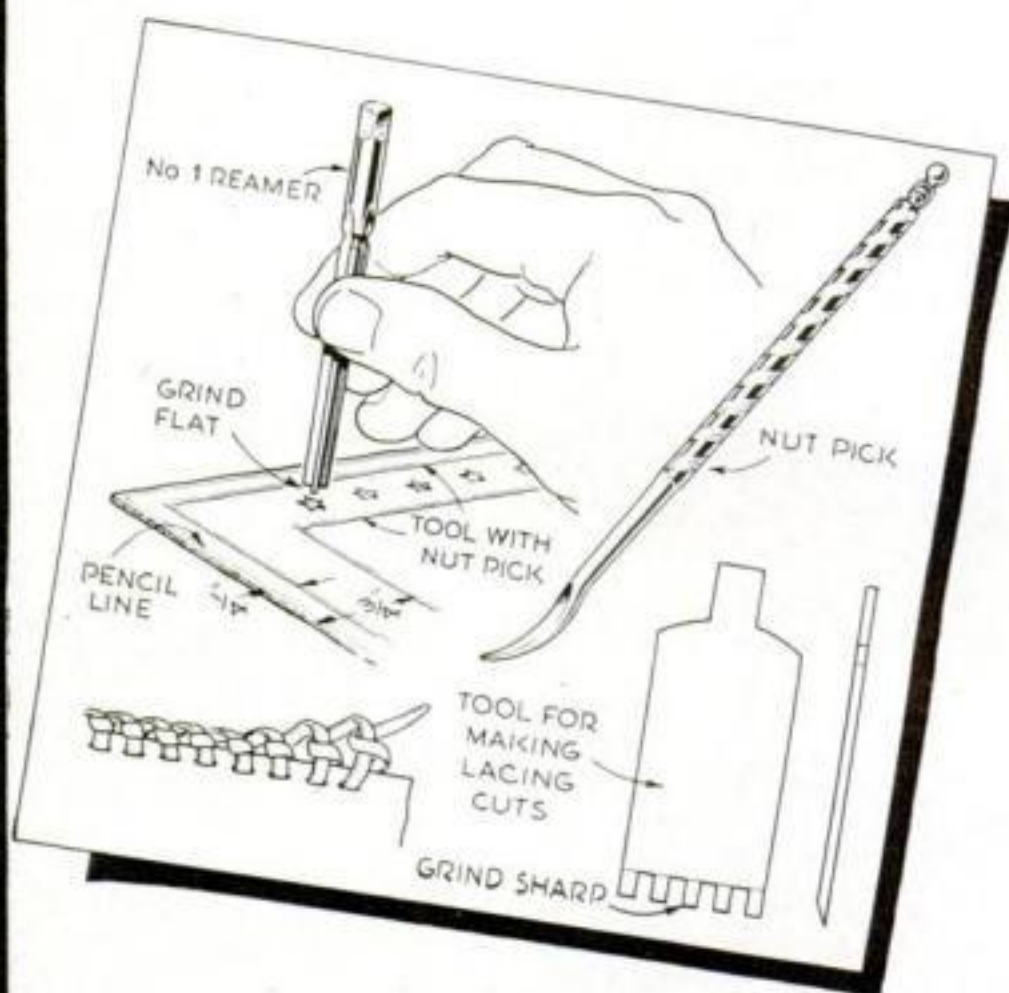
Small parts are best handled in bulk. Sometimes they may be strung on No. 20 soft copper wire and kept separated with glass beads. Both ends of the wire (known as a "slinging wire") are attached to the cathode rod. Still larger quantities can be strung on a number of vertical slinging wires. The cathode rod should be jogged frequently.

Plating barrels of hardwood or stoneware are used for handling small parts on an even larger scale. The barrel is slowly rotated during the plating time, and the tumbling action tends to burnish each part. A copper plate in the bottom of the barrel serves as the cathode. The anode is suspended so that it cannot contact the work as the barrel rotates.

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Tooled-Leather Cover Dresses Up Vacuum Bottle



A VACUUM bottle fitted with a leather cover and handle like the one illustrated is easy to carry on skating and skiing trips, hikes, picnics, or to sporting events. You need no expensive equipment to tool in the attractive design shown.

Wrap a strip of paper around the bottle to find its circumference; then cut a cardboard pattern having a width $\frac{1}{16}$ " less than one third of this circumference and a length $\frac{1}{4}$ " less than that of the jacket of the bottle. Using the pattern, cut three pieces to size from Russian tooling calfskin or lightweight ($2\frac{1}{2}$ -oz.) tooling cowhide.

Draw a line with a hard pencil $\frac{1}{8}$ " from each edge of the leather for the lacing cuts. Moisten the material well on the rough side; then use a blunt-pointed tool such as a nut pick to tool a line $\frac{1}{4}$ " from the edges and another $\frac{3}{4}$ " from the edges. Work on the smooth side, and be careful not to cut through the leather. Between these lines you can punch a star-shaped design at intervals of $\frac{1}{2}$ ", using as a tool a ten-cent No. 1 reamer with the end ground off flat. It is best to try tooling lines and stars on a piece of scrap first.

A prong-type tool saves much time in making the lacing cuts. You can file one from a flat piece of steel to the shape shown.

Grind or file the notched edge sharp. Space the lacing cuts by inserting one prong each time in the last cut made.

Solder or rivet two $\frac{1}{2}$ " wide copper or brass strips to the metal jacket of the vacuum bottle so that the ends project above the shoulder and may be bent into loops for the handle rings. This done, you are ready to lace on the cover.

Goatskin lacing $\frac{3}{32}$ " wide and somewhat darker in color than the tooling leather is suitable. Lace the three parts of the cover together with a simple over-and-under stitch; then carry chain-stitch lacing, as sketched, along the top and bottom edges. Finally, lace the closing joint, but do not pull it tight; leave about $\frac{1}{4}$ " between the edges. Moisten the inner, rough side of the leather again, slip the cover on the bottle, and draw the lacing up tightly. When the material dries, the cover will shrink smoothly and closely to the bottle.

Make the handle of two thicknesses of leather, laced together with a chain stitch at both edges. Fold back the ends after pulling them through the rings, and secure each with two split rivets.

Apply a thin coat of clear shellac to the lacing, and finish the entire cover with two coats of wax.—A. DORFFEL.

SCROLL-SAWED

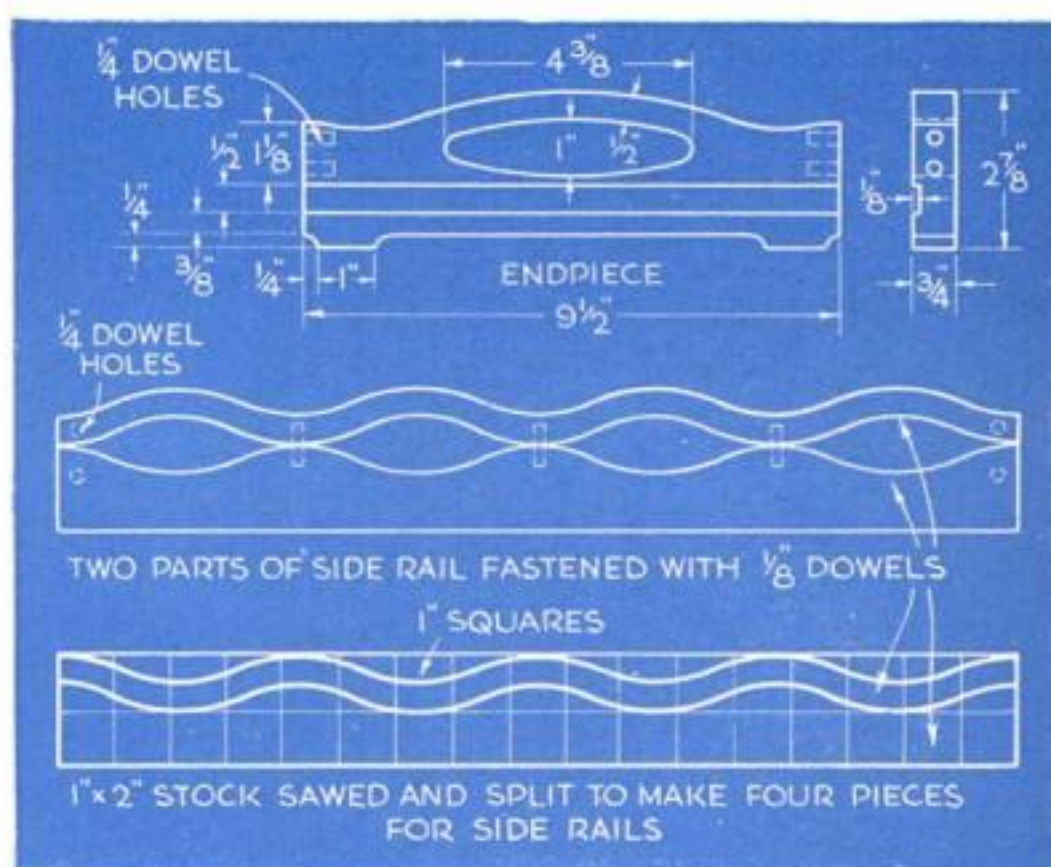
Serving Tray

By BENJAMIN NIELSEN

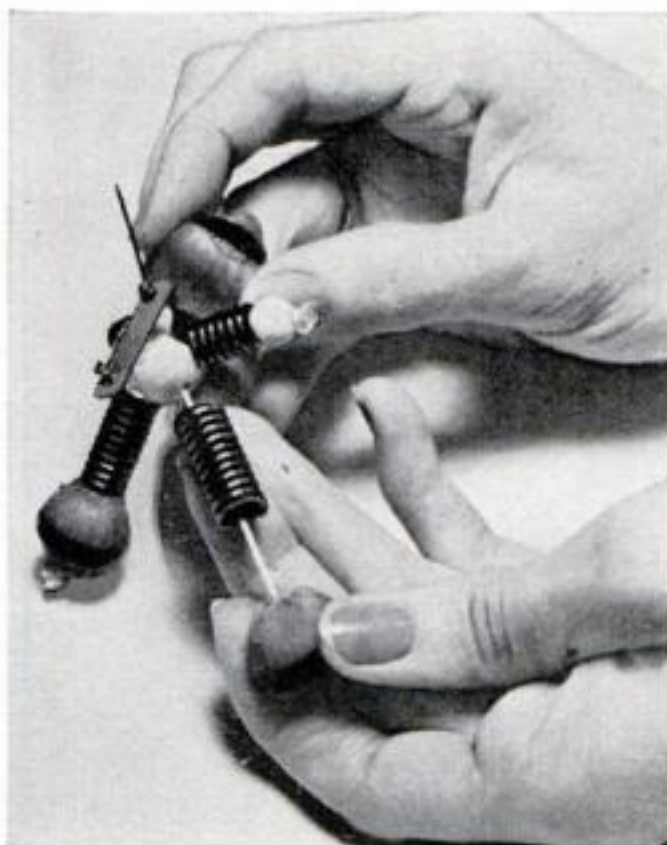
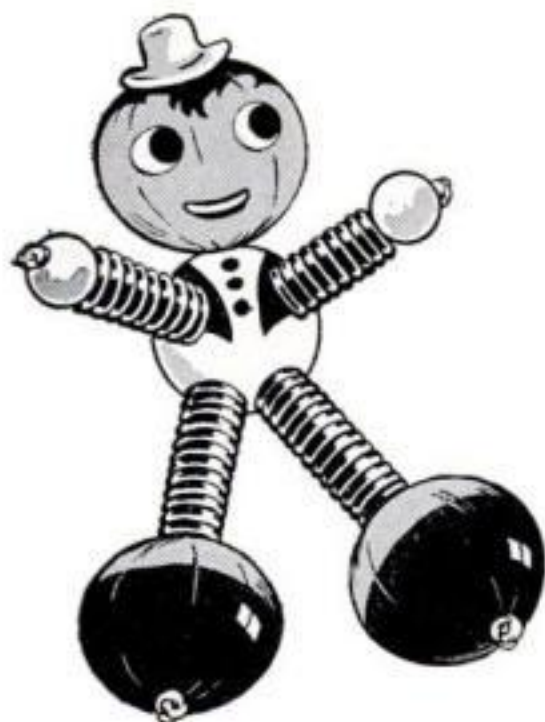
THANKS to the method by which the sides of this tray are made, there is very little waste of material. Only in the endpieces are inside cuts necessary, so the remaining parts can, if the builder prefers, be cut on a band saw.

The bottom is $\frac{1}{2}$ " by $9\frac{1}{2}$ " by $15\frac{3}{4}$ ". One piece of 1" by 2" by 17" stock is used to make the two side rails. Saw it to the shape shown in the drawing, then rip the two pieces in half lengthwise to make four. Finally, dowel the two narrow wavy strips in an inverted position to the wider ones. Cut the endpieces from $\frac{3}{4}$ " material. Each of them receives a $\frac{1}{8}$ " deep dado, $\frac{1}{2}$ " wide, across the inside face for the bottom.

Waterproof resin or casein glue is used in assembling. Several coats of spar varnish serve as a durable finish. This project could also be made with only a hand coping saw, in which case the dadoed grooves are omitted, and the bottom is cut $\frac{1}{4}$ " shorter and 'doweled. Average time, $3\frac{1}{2}$ hours.



Amusing Novelty Pin Formed from Chestnuts and Springs



ALL YOU need to make this "nutty" novelty pin is three chestnuts, four pieces of screen-door spring, one big bead, two small ones, elastic and paint. Drill through two nuts and dip them halfway in paint for the feet. Paint hair and features on the third nut, and buttons and vest on the big bead, in which two extra holes have to be drilled. String the parts on elastic with the springs, tying knots at the ends. Attach the head with glue and a long pin. Carve the hat from wood, glue it on, and cement a pin catch—which may be salvaged from a discarded bit of jewelry—back of the large bead.—B. N.

By JUAN OLIVER

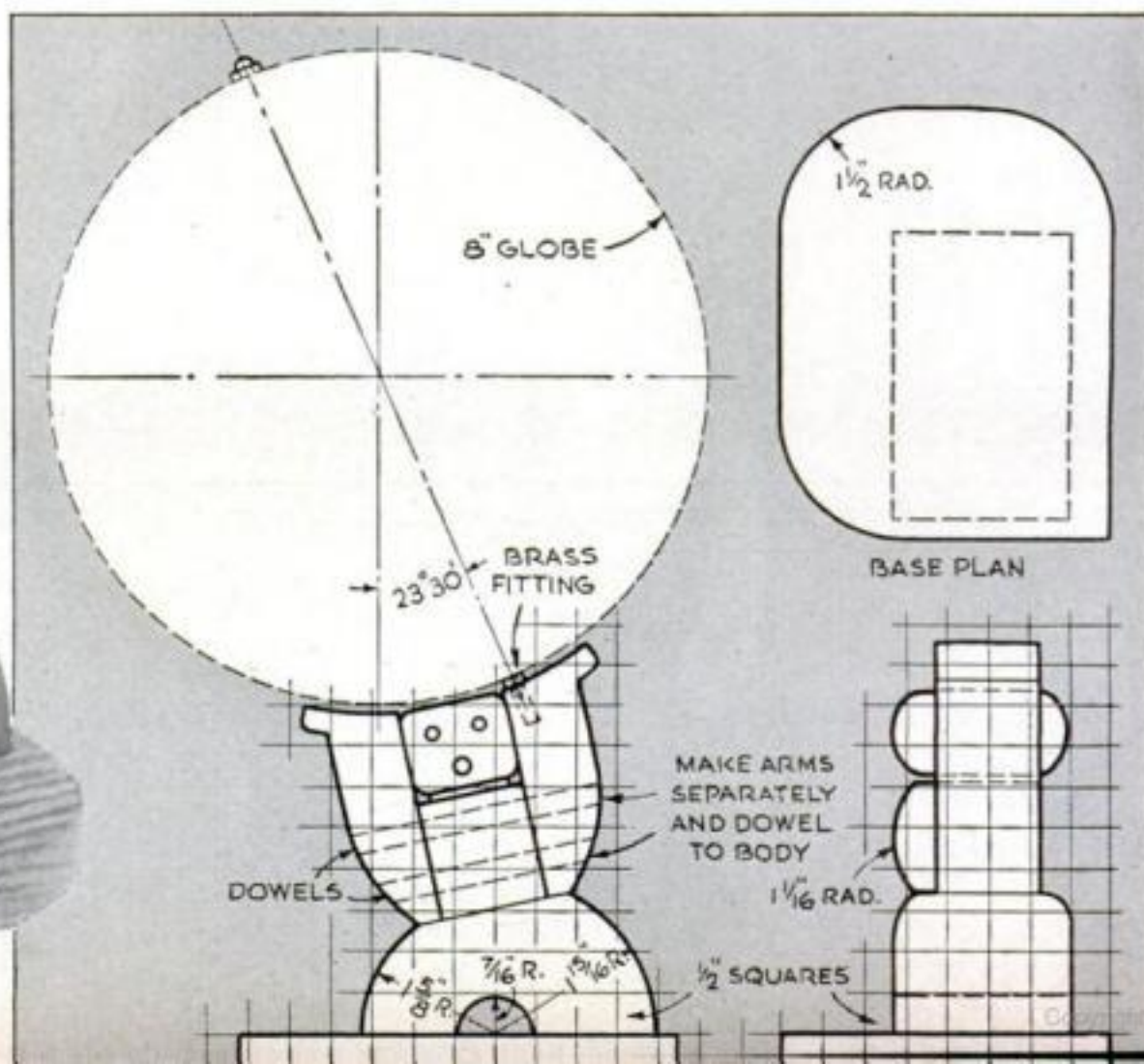
THE Greeks had a name for him—that ancient god or Titan who was supposed to bear the world on his shoulders. Our modern version of Atlas is comparatively easy to make and forms a unique globe standard for the study or library table.

You'll have to buy the globe. One 8" in diameter was used for the original, but you can scale the figure to suit a larger one by drawing the pattern on bigger squares.

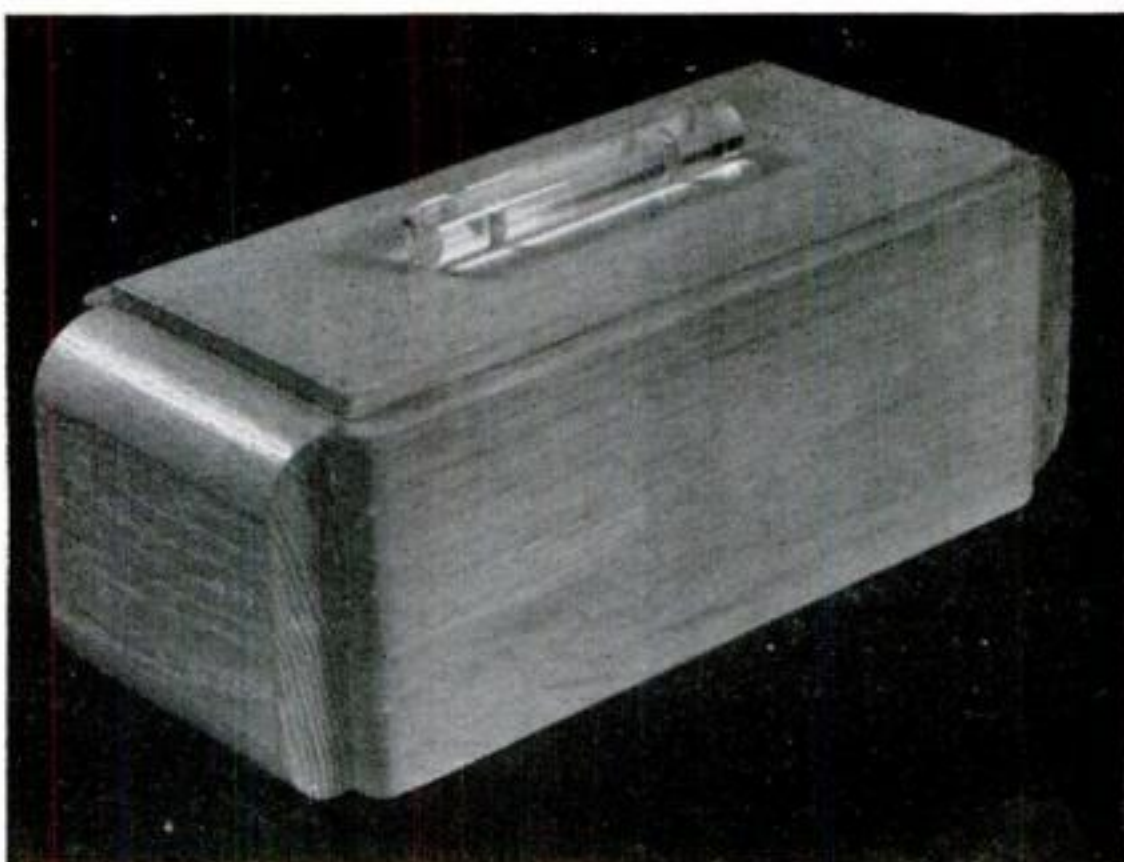
On a $2\frac{1}{4}$ " by $3\frac{5}{8}$ " by $4\frac{3}{4}$ " block of wood lay out both front and side profiles of the body, not including the arms. Band-saw one contour to shape; then tack back the waste on one side so that the block may be held flat on the saw table for cutting the other contour. Finish with file and sandpaper. Saw the arms from $1\frac{1}{4}$ " stock, clamp them in place on the body, and drill through all three pieces at once for two $\frac{1}{4}$ " dowels. Assemble with glue. Spot eyes and mouth with shallow drill holes. Attach the figure to the base with four small countersunk screws.

The original threaded shaft on which the globe spun and a brass shaft fitting in its base are utilized to fasten it to the new support. Simply drill a hole in the top of the higher arm at exactly $23\frac{1}{2}$ deg. to the vertical and of such a size that the brass fitting must be pressed in firmly.

ULTRAMODERN FIGURE OF ATLAS SUPPORTS GLOBE



dresser box conceals facial tissues



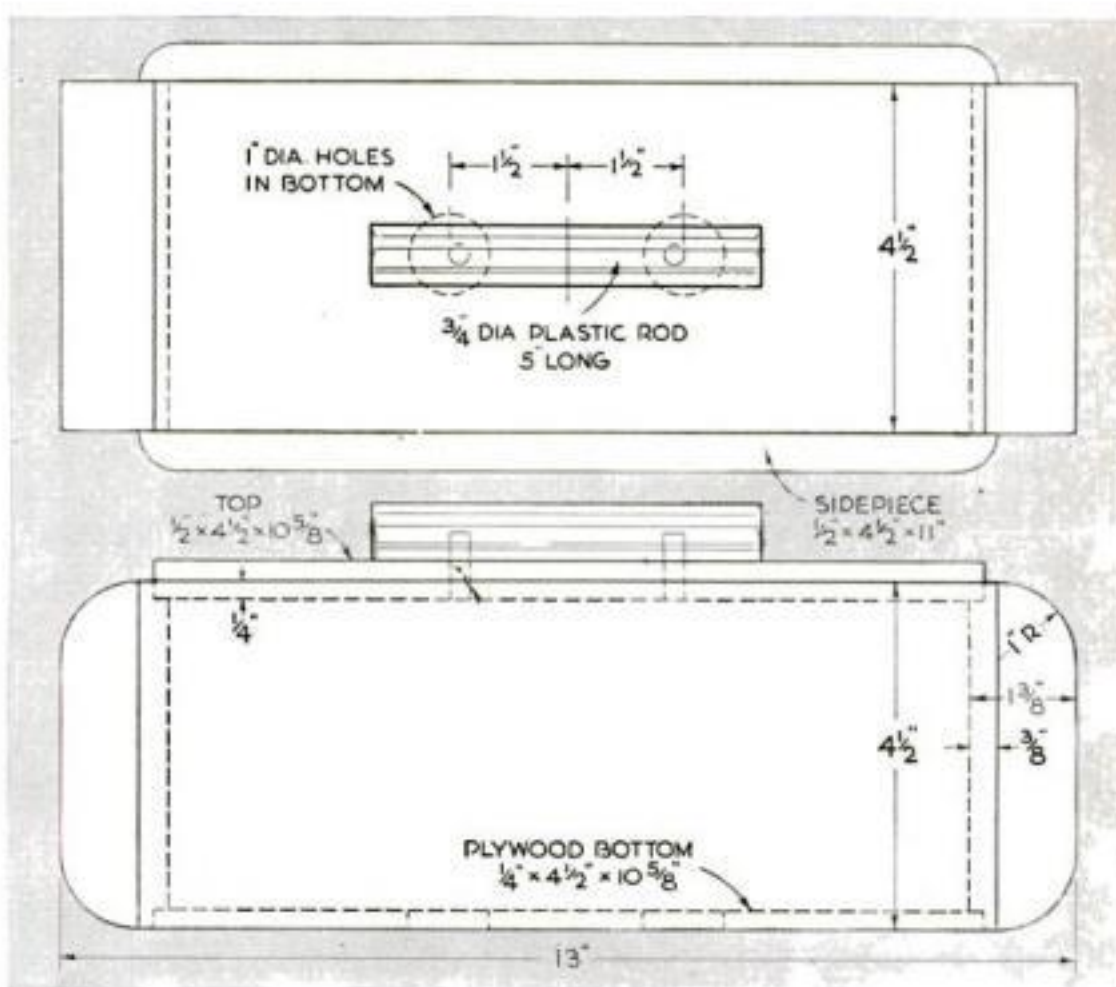
A DISTINCTIVE PROJECT BY JUAN OLIVER

MILADY will like this box for facial tissues, so indispensable to the vanity or dressing table. It holds a standard carton of over 400 sheets, harmonizes with modern decorating schemes and furniture, and is surprisingly easy to make. The cardboard container is inserted bodily, and tissues may be pulled out one at a time in the usual way. Be sure to check the dimensions given against a box of the preferred brand of tissues, as sizes may vary.

Oak was used for the original. This wood lends itself to a modern "pickled" finish. Square up the endpieces from $1\frac{3}{8}$ " thick stock, but do not round off the edges yet. Cut a lid of $\frac{1}{2}$ " stock and a bottom of $\frac{1}{4}$ " plywood to identical dimensions. If one or two large holes are bored in the bottom, it will facilitate removing empty cartons. Rabbet the top and bottom edges on one side of each endpiece to receive the lid and bottom; then sand all surfaces smooth.

The box can now be assembled with glue and brads. Sink the latter and fill the holes with plastic composition wood or crack filler. After the glue has set, plane or sand the outer top and bottom edges of both endpieces round, as shown in the drawing. A sander will make short work of this.

A handle of $\frac{3}{4}$ " diameter crystal plastic rod may be attached by means of two wood-



As simple to make as it is pleasing, this box holds cleansing tissues. All the work can be done with saw, sander, and hand drill

en dowel pins glued into the lid and pressed into holes in the plastic. These may be drilled undersize, and if the plastic is heated before the pins are inserted, it will shrink on cooling and hold them firmly.

If plastic rod is not available, an ebony handle, or a plastic drawer pull of appropriate design, may be used instead. In any case, the handle should provide contrast.

Rub flat gray or white paint thoroughly into the pores of the wood, let it dry, and follow with two coats of wax or clear lacquer.

VARIETY lends zest to craft-work as to other things. If you usually build large pieces, you may occasionally enjoy completing a project in an evening or two. These useful articles will well repay you for a few hours' pleasant work.

CHEESE AND BREAD BOARD. That 10-o'clock snack can be graciously served with the help of this accessory. Chestnut is a good choice for the board and the cover base. Handles and knob may be turned from mahogany. The cheese cover is a stock glass bowl.

To drill for the knob screw, grind a triangular file to a point, keeping the three edges sharp, and use this in a hand brace or at low speed in a drill press. Drill from the other side as soon as the point breaks through. Use turpentine freely as a lubricant. Add silicon-carbide for speed.

The cover base is turned to fit the cover and dadoed $\frac{3}{16}$ " deep and $1\frac{1}{8}$ " wide on the underside for the cheese knife. Leave it unfinished, and screw it in place after applying three coats of shellac to the handles

Cheese Board and Tilting Clock

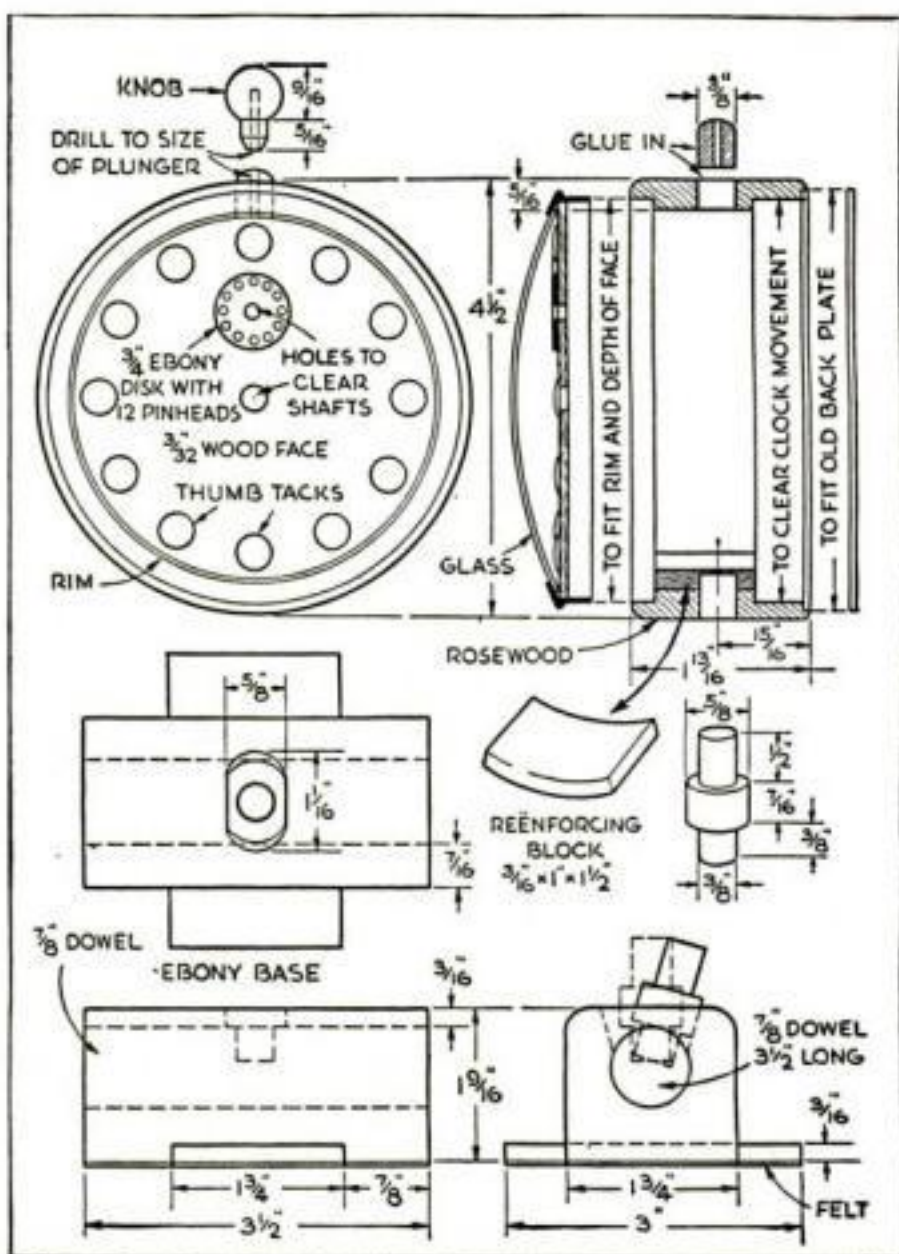
**TWO UNUSUAL PROJECTS BY
ERNEST R. DEWALT, INDUSTRIAL
DESIGNER AND CRAFTWORKER**

and board proper. The knob can be shellacked and French polished in the lathe. Approximate time, 4 hours.

CRYSTAL PLASTIC KNIFE. Cut out the blade with a fine-toothed saw from $\frac{1}{8}$ " thick clear plastic. File or sand the ends and a 15-deg. cutting bevel to shape. Polish the edges



Face lifting and a new body may not improve the ticking of the old clock, but they make it look younger. Spanish cedar is a handsome face . . .



. . . Use $\frac{3}{32}$ " cedar and mark off the hours with rivets or thumb tacks. Ebony or other hardwood will do for the body, base, and alarm-setting dial



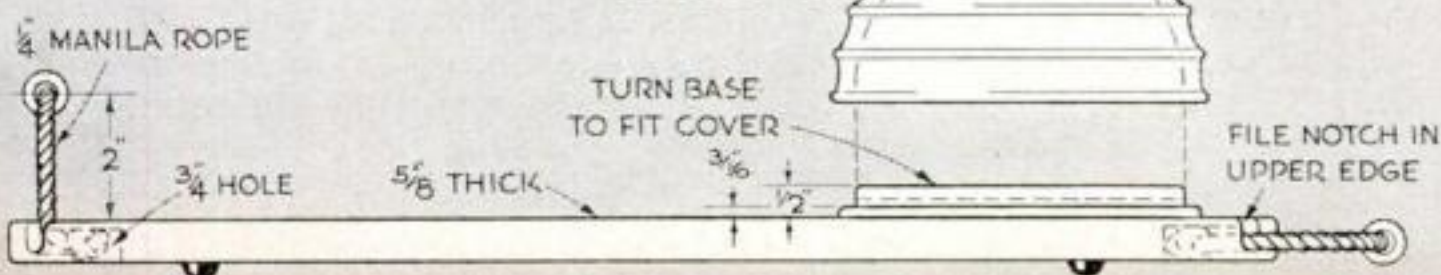
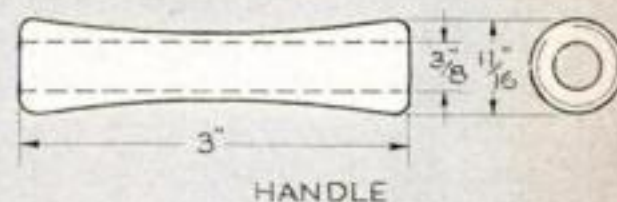
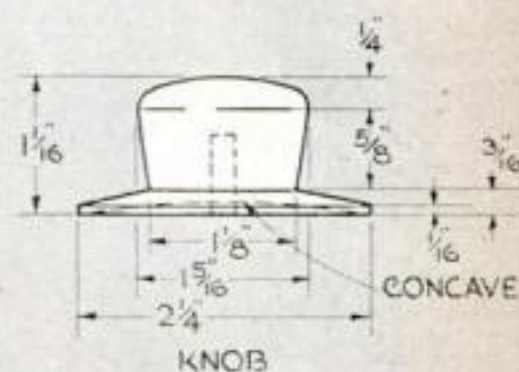
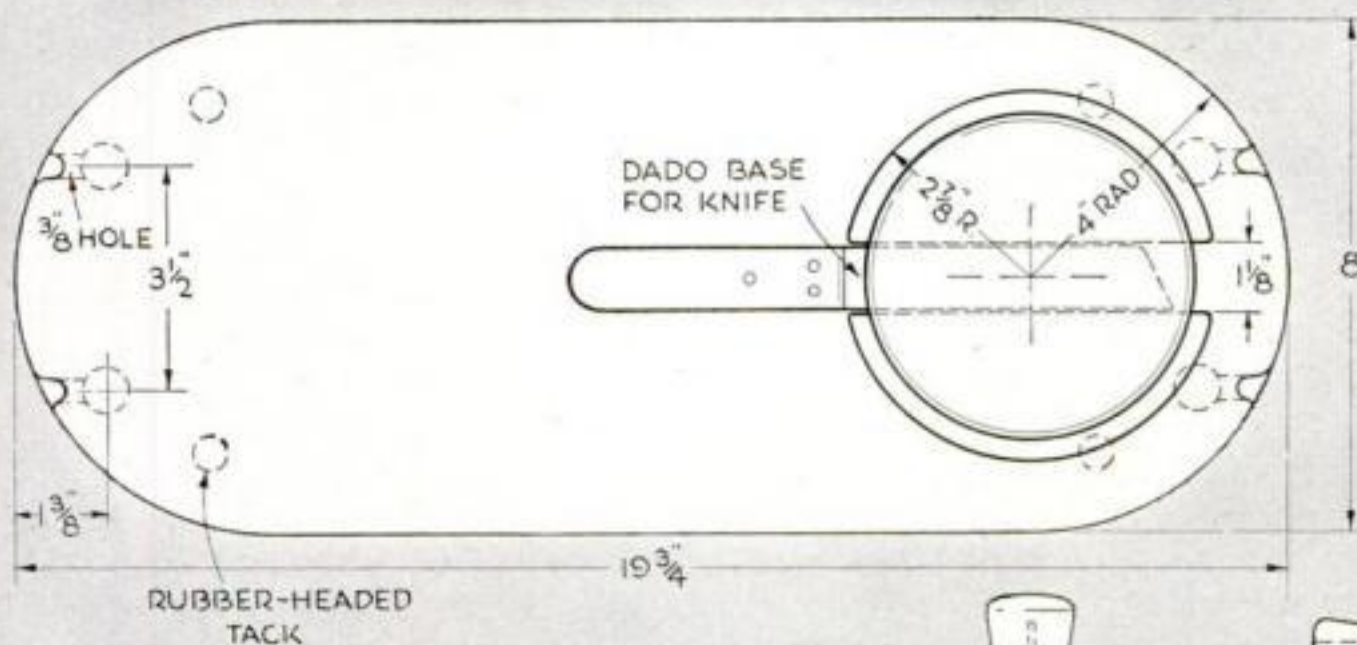
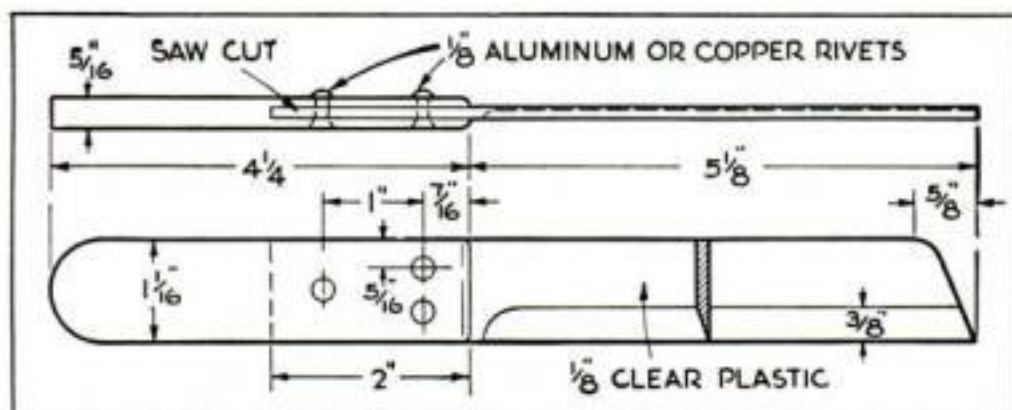
For an easy, quick snack, the cheese board is the hostess' best helper. It also saves extra plates

with fine silicon-carbide paper, used wet, and buff on a cloth wheel. Slot the mahogany handle for the blade, which is fastened with aluminum or copper rivets. Finish with shellac. Approximate time, $2\frac{1}{2}$ hours.

TILTING CLOCK. An old-fashioned clock can be spruced up with this tilting stand and case.

Turn the hardwood body out to the dimensions of the old housing, with rabbets for the old clock's front rim and back plate. Glue in a curved reinforcing block where the dowel joint comes at the bottom. Bore the base lengthwise for the $\frac{7}{8}$ " diameter tilting pin, and dado a $\frac{3}{16}$ " thick piece crosswise for a footing. Aluminum rivets are best for the hour points, but thumb tacks will serve. Bend the hands to pass freely around the new face. Three coats of clear lacquer may be used, and the face left natural. Paint the hands flat black. Time, 6 hours.

Board and cheese-cover base are assembled with screws from the underside. Dado a slot on the bottom of the round base to receive the blade of the plastic knife



Kit-Built



Curtis P-40, 24" wing, made from a one-dollar kit. A low-wing scale model for the experienced builder

THOUSANDS of men and boys have found model-airplane building an ideal hobby. Perhaps the easiest way to get started in it is to buy a construction kit, but thousands of the kits sold are never turned into completed models. The suggestions that follow may help the beginner to avoid the pitfalls before him, and enable the experienced builder to get better results from his next kit.

No sounder advice can be given a newcomer to the hobby than to build the so-called "baby R.O.G.," or small rise-off-ground model. This takes only a few hours, but will teach one how to use balsa, install rubber motors, and make adjustments.

Kits are available for three main types of ships: scale models, rubber-powered endurance models, and gas models. Scale models are hardest to build so as to fly well. The high-wing designs lend themselves best to flying. Endurance models are most instructive of all. Designed to fly as

long as possible, they are stripped to essentials and given as large rubber motors as they will carry. They also afford the quickest means of getting into competitive flying. Gas models, although impressive, are probably the easiest of all to build, but a balky motor may take longer to get into working order than the plane. Handling of these dynamic little power plants is learned only by experience.

Because beginners do not know how to check their ships, they often turn their gas models loose without sufficient testing, and the results are frequently disastrous. It is safer to gain experience with rubber-powered models before investing in more expensive equipment. It is also a good plan to buy the motor first and thoroughly run it in on the bench before building the ship. Experimenting with a new motor installed in the plane is hazardous at best. Price is a fairly good indication of motor quality; however, if you plan to fly only for fun, a

Airplane Models

THEY ARE A BEGINNER'S BEST BET, SAYS FRANK ZAIC, WHO TELLS HOW TO MAKE THE MOST OF STOCK PARTS AND PLANS

low-priced motor should prove satisfactory.

Prices are also somewhat of a barometer of kit quality. Although they start at 10 cents, the beginner will probably get more satisfaction from one in the 25-cent or 50-cent class. In scale models, 5 cents per inch of span is an average price, but the builder should be prepared to buy such extra material as may be necessary. Many good kits for endurance models sell for one dollar, but for this type of ship the builder should expect to buy extra rubber.

Tools are less important than skill in using them, but the serious model maker will eventually acquire the following: T-square, drawing board, French curve, triangles, rulers, steel straightedge, small block plane, hand drill, round-nose pliers, soldering iron, and needle files.

If you haven't a workshop, the kitchen is the logical place for you to work, because it is easy to clean and usually has plenty of table space. Pin the piece in process on a big, soft board so that you can put it away on the board when necessary.

A check-up of the kit should be made be-

fore starting work. Longerons, spars, and other loaded members should be of hard balsa. If that supplied is not the right grade, buy extra material instead of spending time building a faulty structure. Study the drawing and be sure you understand it before you cut any material.

Be watchful of scale effects. Stringers on a large ship, for example, form longitudinal lines on the covering, but the bulkheads do not show in this way. If the plans call for stringers to be flush with bulkheads, use your own judgment and make the bulkheads slightly smaller. The two effects are illustrated in the drawings.

Paper-covered parts must be well fitted before covering. The drawings show typical faults in wing construction. Smooth all balsa carefully with sandpaper. Nicks and scratches weaken structural members.

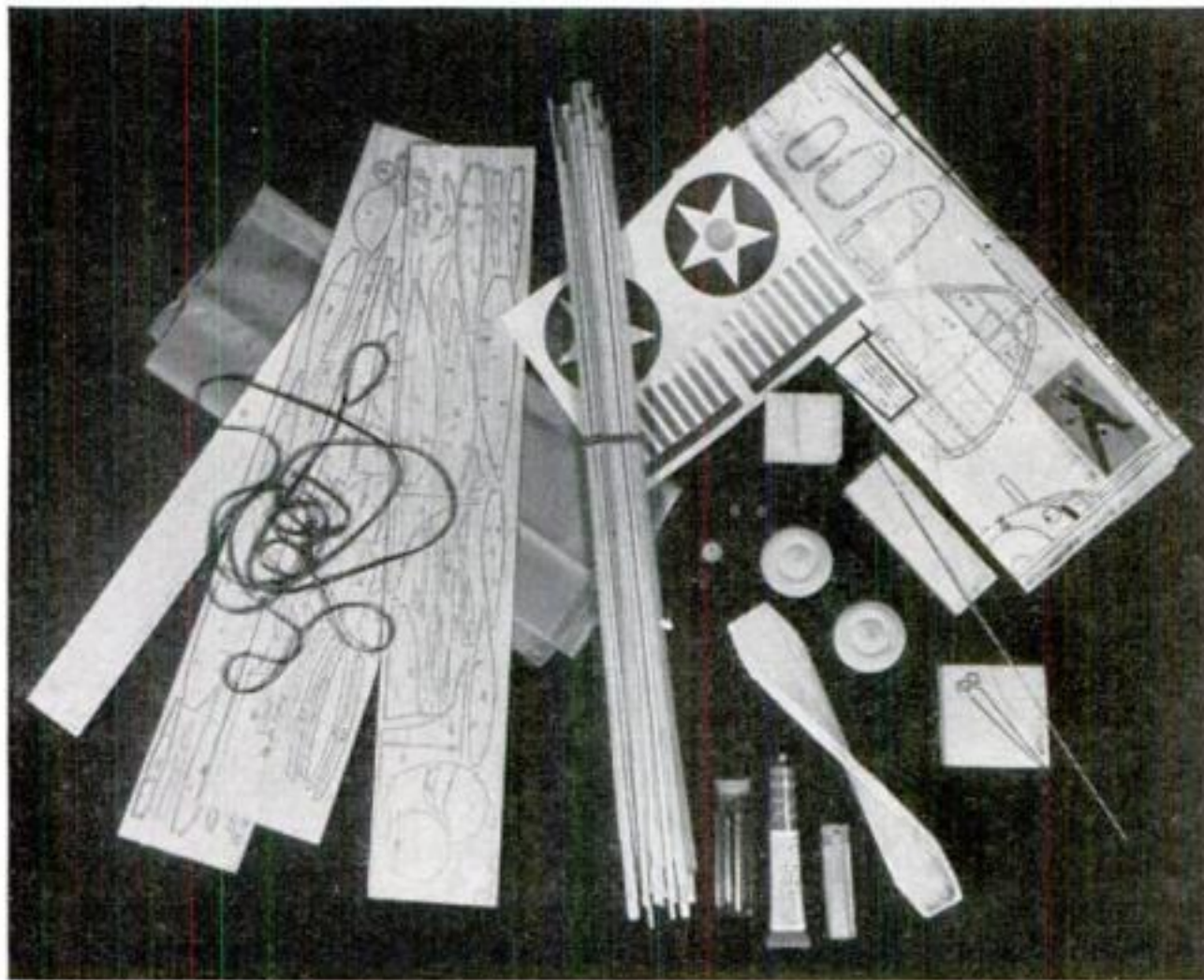
Struts, landing gears, and rudders can be firmly attached with steel-wire or bamboo pins, as illustrated. Never cement such members to the covering, but cut away the paper and make a wood-to-wood joint.

Bad covering can spoil a well-built model.

Apply paper before struts and similar parts are cemented in place. On a wing top, first tack paper to the center of the middle rib with dope slightly thickened with cement. Coat the entire top edge of the last rib at the tip; then draw the paper taut in the form of a triangle, as shown. Lift the loose edges, coat the middle rib and spars, and pull the paper smoothly down over them. Trim edges and paint them with dope.

The lower wing surface can be covered in the same way if it is flat or convex, but if it has an undercamber, the paper must be cemented to every rib.

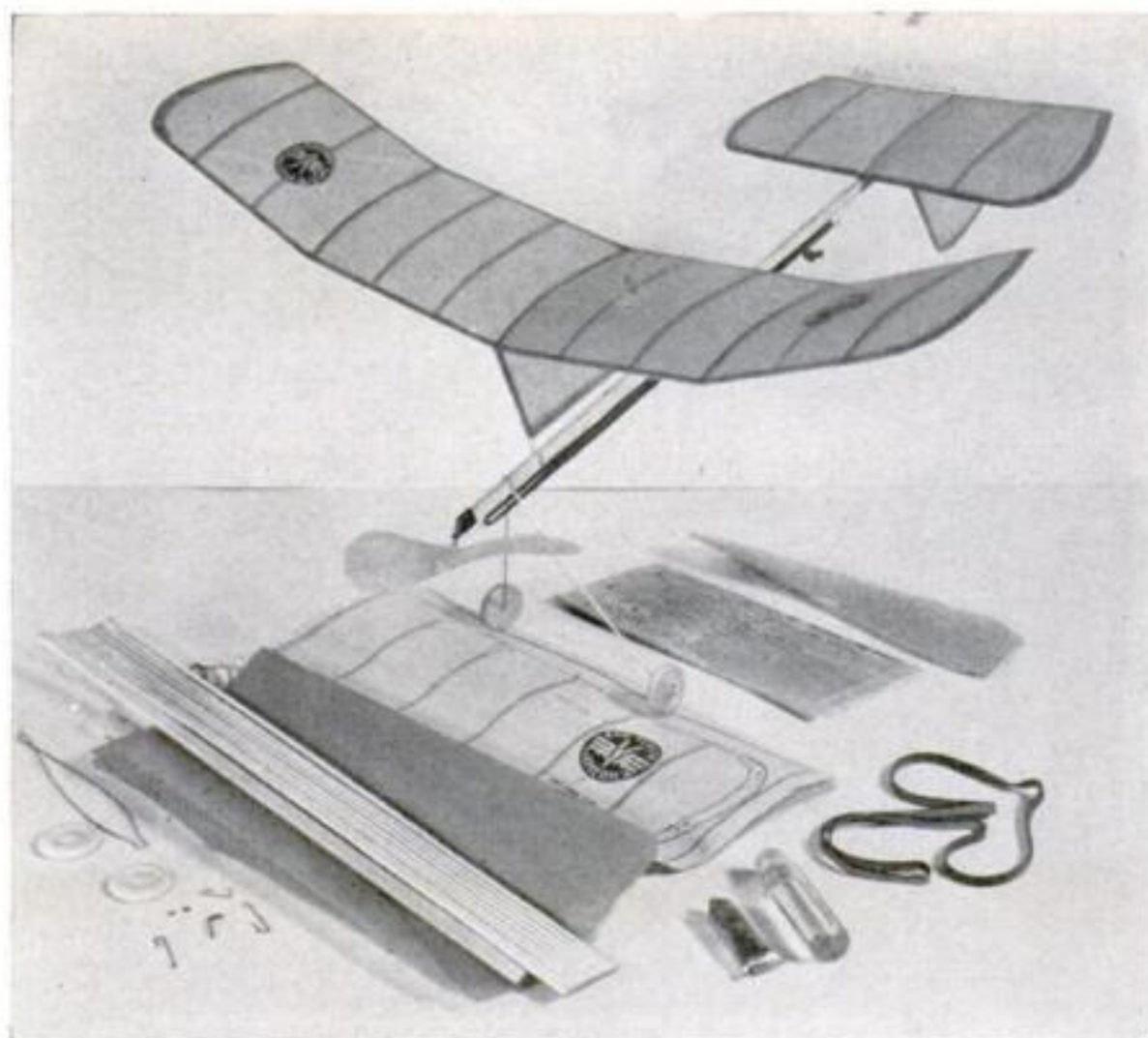
For curved areas, use wet silk or the type of tissue that can be mois-



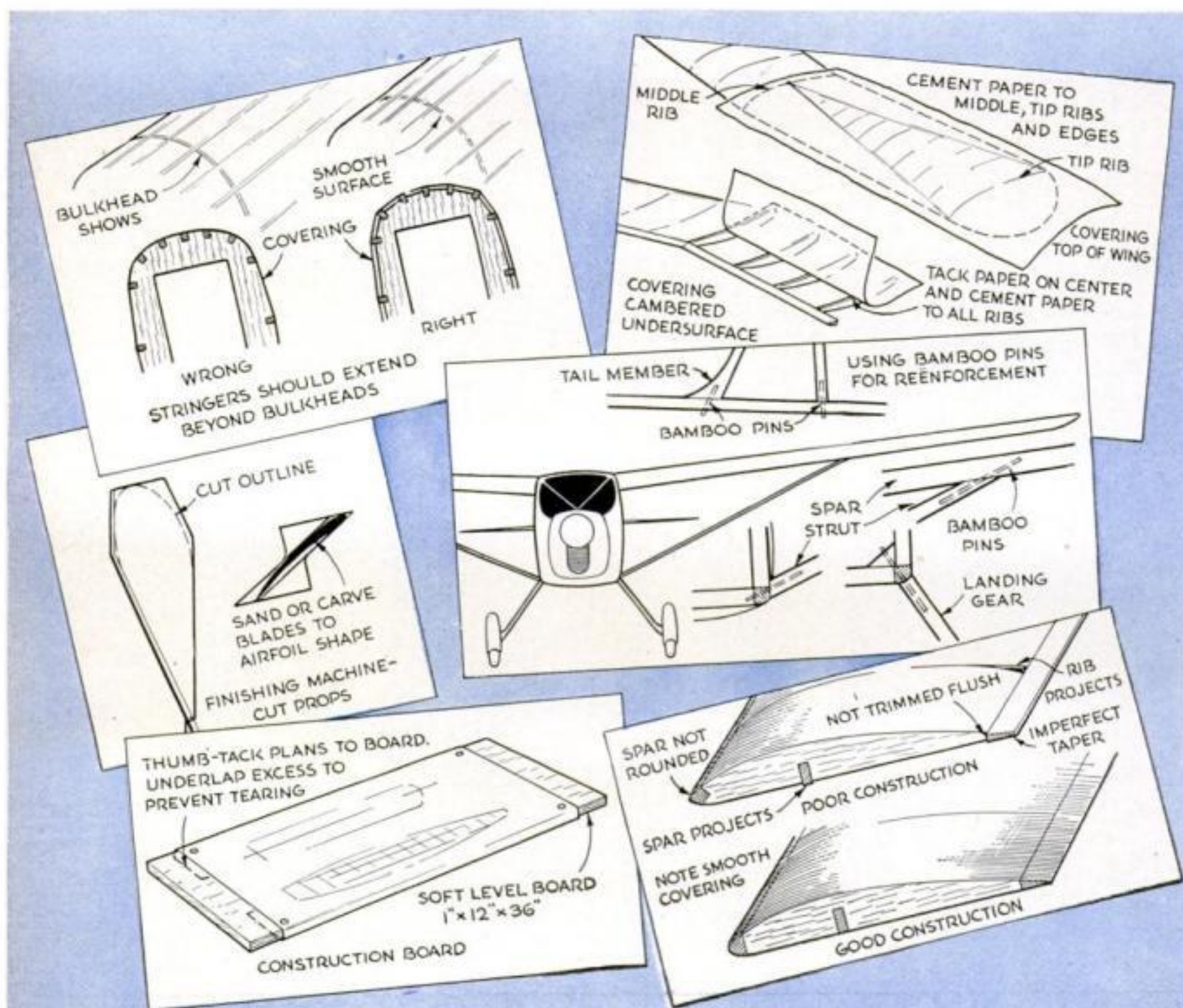
Contents of kit for making the ship on the facing page. The beginner should gain experience on simpler models before attempting this type

tened. The dope will "blush" (turn white) on wet surfaces, but this can be eliminated by applying thinner after the cement has dried. If paper is applied dry, it can be slit and overlapped at curved parts, but should be sprayed with water before doping. An insecticide sprayer will do for this. One or two coats of clear dope are usually enough; more make the paper brittle. All colored dopes loosen the covering instead of tightening it, so use more coats of clear dope underneath.

Propellers are a great stumbling block. Many machine-cut blanks provided in kits have too high a pitch and not enough blade area. It is often best to buy an extra block and carve your own prop (see P.S.M., June '41, p. 194).



Ideal for the beginner is this advanced R.O.G. model, third of a series approved by Air Youth of America. The kit, shown under the finished model, sells for 25 cents. Below, some construction pointers



Cash Prizes

FOR TIN-CAN PROJECTS

SHEET copper, brass, and aluminum are now so difficult for the amateur craftsman to obtain that he will have to rely more and more upon that good old stand-by, the tin can.

To develop as many ways of using tin cans as possible and to encourage their use in place of materials vitally needed for war, we should like to enlist the aid of our readers. Please submit all the good ideas you can think of. To make it more interesting and to encourage a little friendly competition, we will award \$100 in prizes for the most useful, practical, and original suggestions as follows:

FIRST PRIZE.....	\$50
SECOND PRIZE.....	25
THIRD PRIZE.....	10
15 PRIZES, \$1 each.....	15

Each project must be made mainly from tin cans, although any necessary accessories may be used, such as wire, solder, wood, glass, and paint. Mail your entry, carefully packed and fully prepaid, to the Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y., to arrive on or before March 31, 1942. No entries will be returned. If you do not wish to part with your model or if it is difficult to pack for shipment, simply send a photo, description, and any necessary sketches.

The contest is open to all except employees of POPULAR SCIENCE MONTHLY. The judges will be the editors of this magazine, whose decision will be final. In case of ties, each tying contestant will be awarded the prize tied for.

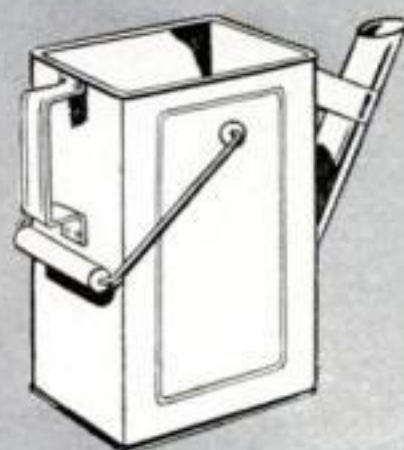
SUGGESTIONS FOR THE USE OF TIN CANS

Ash trays	Flour, sugar, or nut scoops	Monogram plates
Belt buckles	Fruit bowls	Napkin clips
Book ends	Garden lanterns	Nut dishes
Camping equipment	Garden sprinklers	Pen and pencil trays
Candleholders	Hand blotters	Picture frames
Cookie cutters	Ink wells	Place-card holders
Costume jewelry	Lanterns	Puzzles
Cuff links	Letter or paper knives	Sandwich tongs
Door stops	Letter racks	Sconces
Escutcheons	Match boxes	Table centerpieces
Flower bowls and vases	Memo-pad holders	Tie clips
Flowerpot holders	Models	Toys
		Wall lamps

RELISH
DISH



WATERING CAN



LANTERN



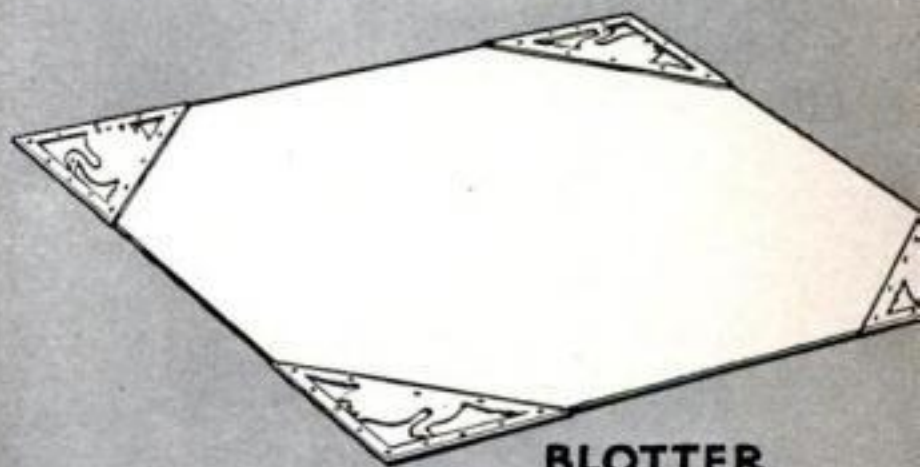
MINT DISH



SCONCE



OIL MEASURE



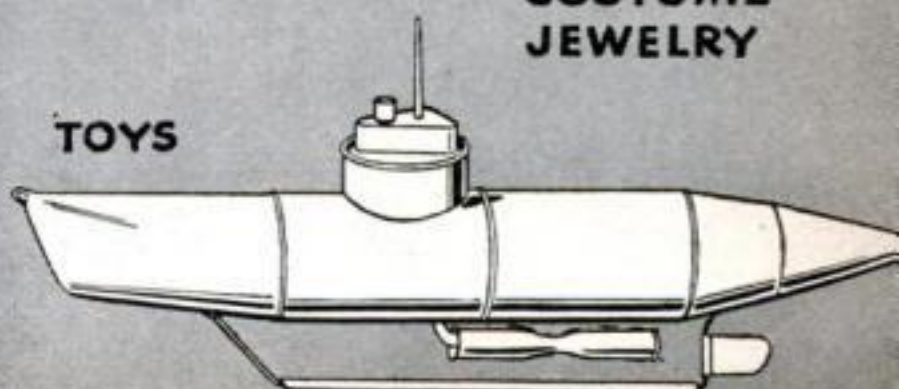
BLOTTER
CORNERS

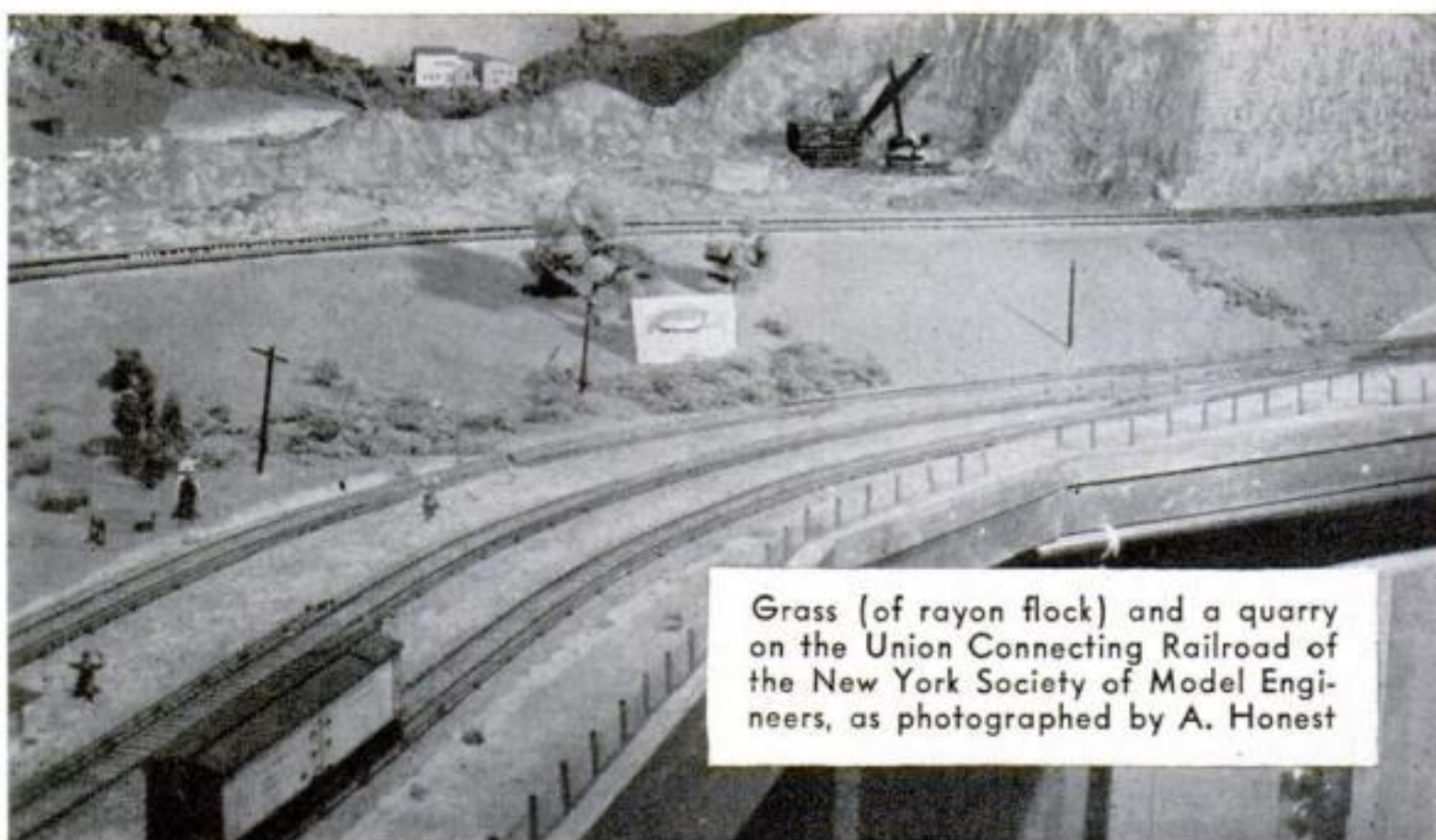


COSTUME
JEWELRY



TOYS





Developing the Main Line

By **DAVID MARSHALL**

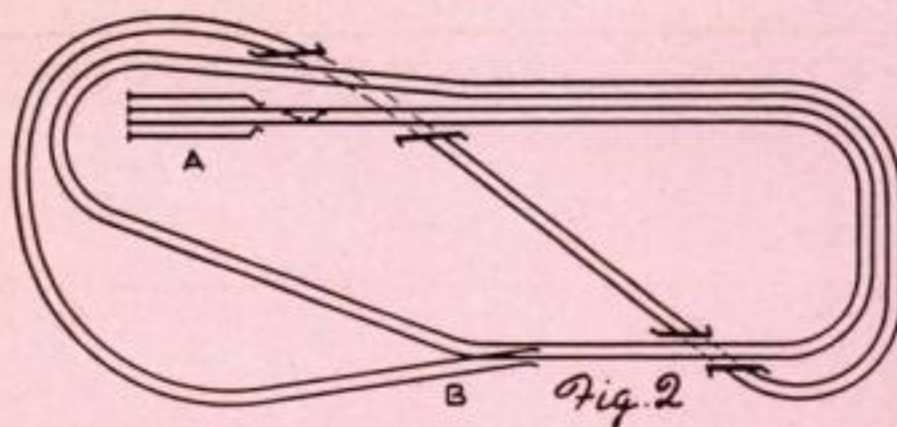
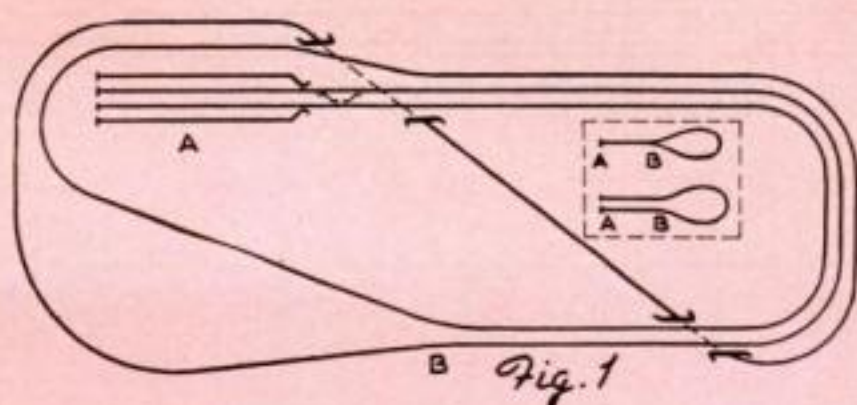
Author of *Model Railroad Engineering*

THE three basic layouts—the continuous, point-to-point, and out-and-home lines—were dealt with here last month. Any one gives you your basic plan, a single-track main line, but it's only the skeleton. The process of *developing the main line* lies ahead. We now begin that process, remembering two things: 1. The object of model railroading is to carry on a condensed, accurate form of standard railroading. 2. The main line must provide for as many as possible of the standard maneuvers of "grown-up" railroads.

DOUBLE-TRACKING. It may be possible to double-track only a portion of your main line and yet achieve the effect of total double-tracking. In Fig. 1 an unusual layout results from double-tracking the stem

of an out-and-home line from A to B—at which point the two tracks part to form the reversing loop. This has one special virtue; apart from those at the terminal, it makes use of no switches. One person can operate the entire railroad for, with the correct routes set up at the terminal, every train that leaves by the outbound track must return by the inbound. A collision caused by a fast train overtaking a slow one can be guarded against by correct spacing as the trains leave the terminal.

Such a layout, however, would soon be bankrupt of interest for a large group. The one good effect in double-tracking its entire length (Fig. 2) is to introduce a double-tracked junction at B, with three pairs of routes that foul each other and three pairs mutually acceptable. This junction can be the happy preoccupation of years. But nothing else is gained through all the additional double-tracking; and as we reckon up the



cost, it becomes apparent that double-tracking can sometimes be uneconomical.

SINGLE-TRACKING. Single-track working is the most interesting form of railroading. In Fig. 3 the layout of Fig. 1 is double-tracked through *B* just far enough to let the diverging routes disappear in the hills. Thus we have our junction at *B*, and for half the cost of total double-tracking. Also we have a single-track division from *C* to *D*. Over this two-way running is the order of the day. "Meets" must be arranged without loss of time to either train. The engineer arriving at either *C* or *D* may have to wait there till a train running "against" him clears the single-track line; when the "meet" is executed, he has authority to enter the single-track division. The switches at *C* and *D* are both sprung closed, requiring no attention. The trains facing them will always take the right-hand track, yet trains can trail through from the rear by either track.

SIDINGS. Sidings are the almost inevitable accessories of single-track working. Extremely important to remember is that a siding is part and parcel of the main line. The laws of high iron apply to it, and therefore it is *not a side track*, which is legally a yard—low iron. The more usual type (*A* in Fig. 4) is designed to permit one train to pass another. Both switches are sprung closed and require nobody to look after them.

The lower sketch (*B*) shows a lap siding, which provides facilities for a three-way meet, normally involving two trains running against each other and a fast express overtaking and passing one. This can provide one of the finest

At right, operation of "sawing" two long freights past each other on a short siding. The maneuver can be followed with the arrows. Below, double-tracking and siding examples

spectacles in the whole book of model railroading. Two opposite trains are timed to arrive together for a "headlight meet." They drive headlong at each other, then swerve away, each moving to the right where the sidings overlap. The west-bound train waits on track *X* and the east-bound on track *Y* for the third train, which roars down the through track between them, whistle shrieking. Other whistlings follow as the two other engineers acknowledge her signals. If the signal consists of two long and one short, the meet is executed. But if it's one long and two short, the express, showing green flags, is running in two sections, and the second section follows.

TRAIN SAWS. It's obvious that every siding must be long enough to accommodate your longest passenger train. But you may have freight trains much too long, and may even find two of these fellows at once approaching a siding too short for either. In that case a train saw results—and that is the maneuver by which the two trains "saw" past each other. This is outlined in Fig. 5.

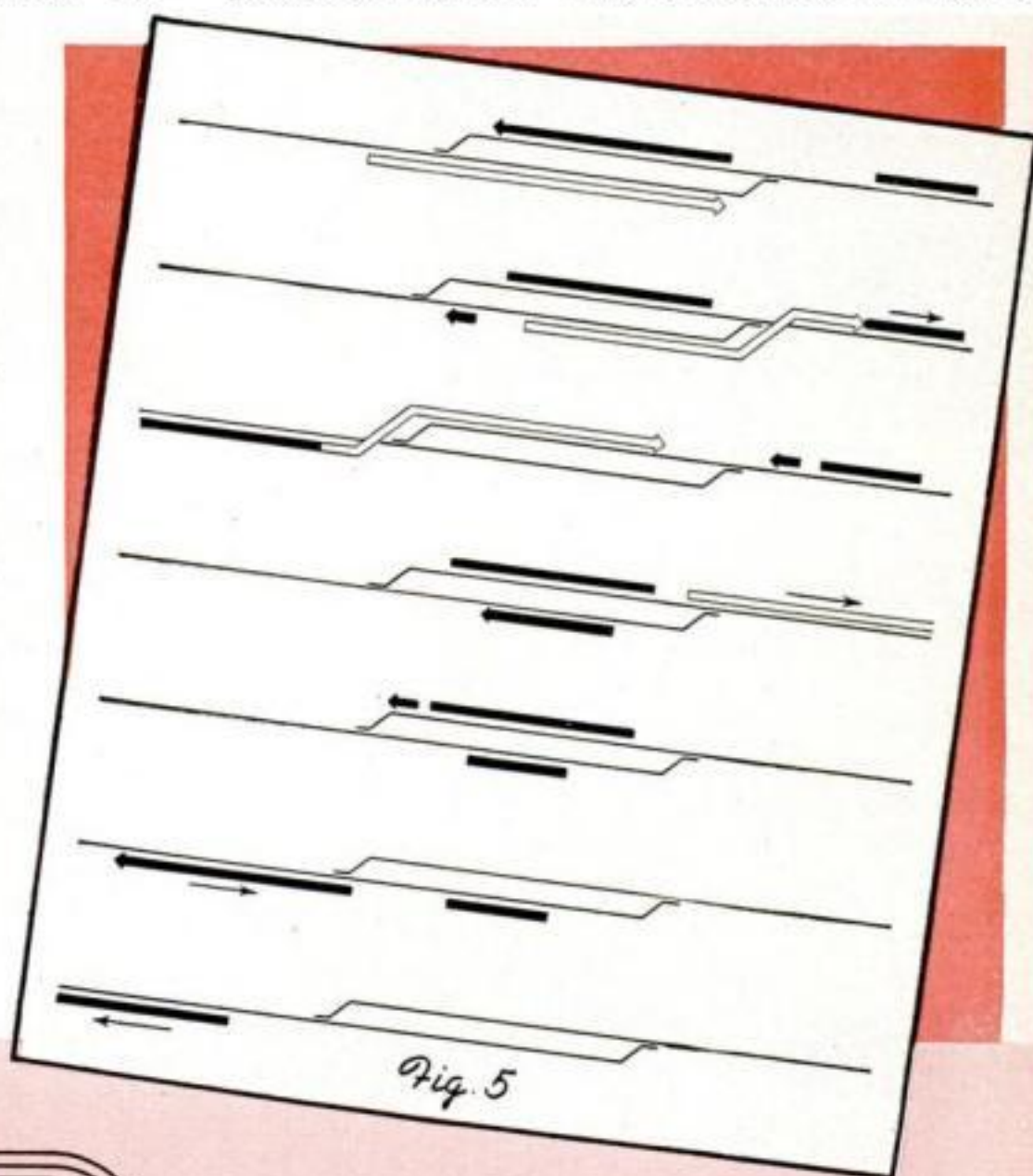


Fig. 5

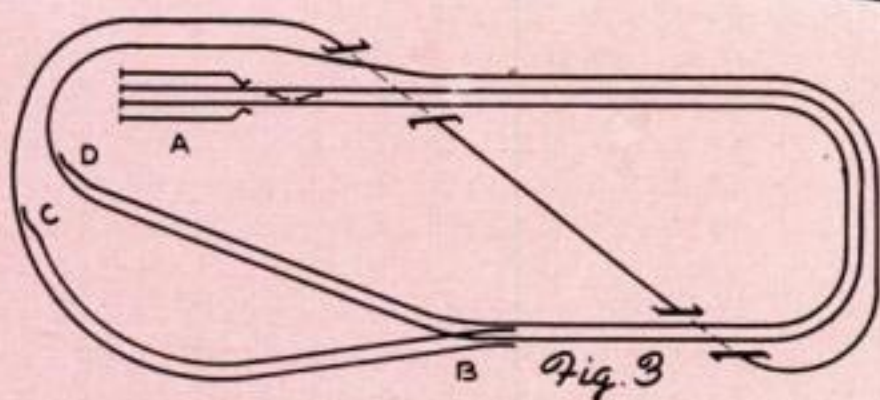


Fig. 3

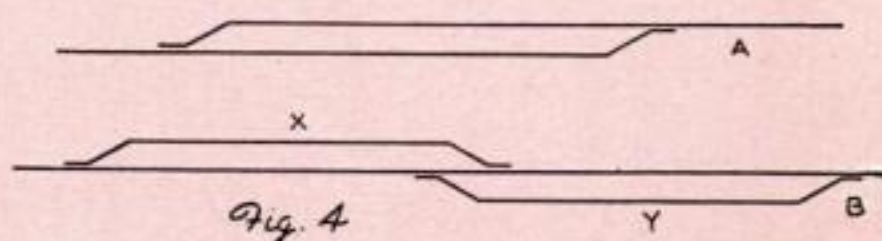
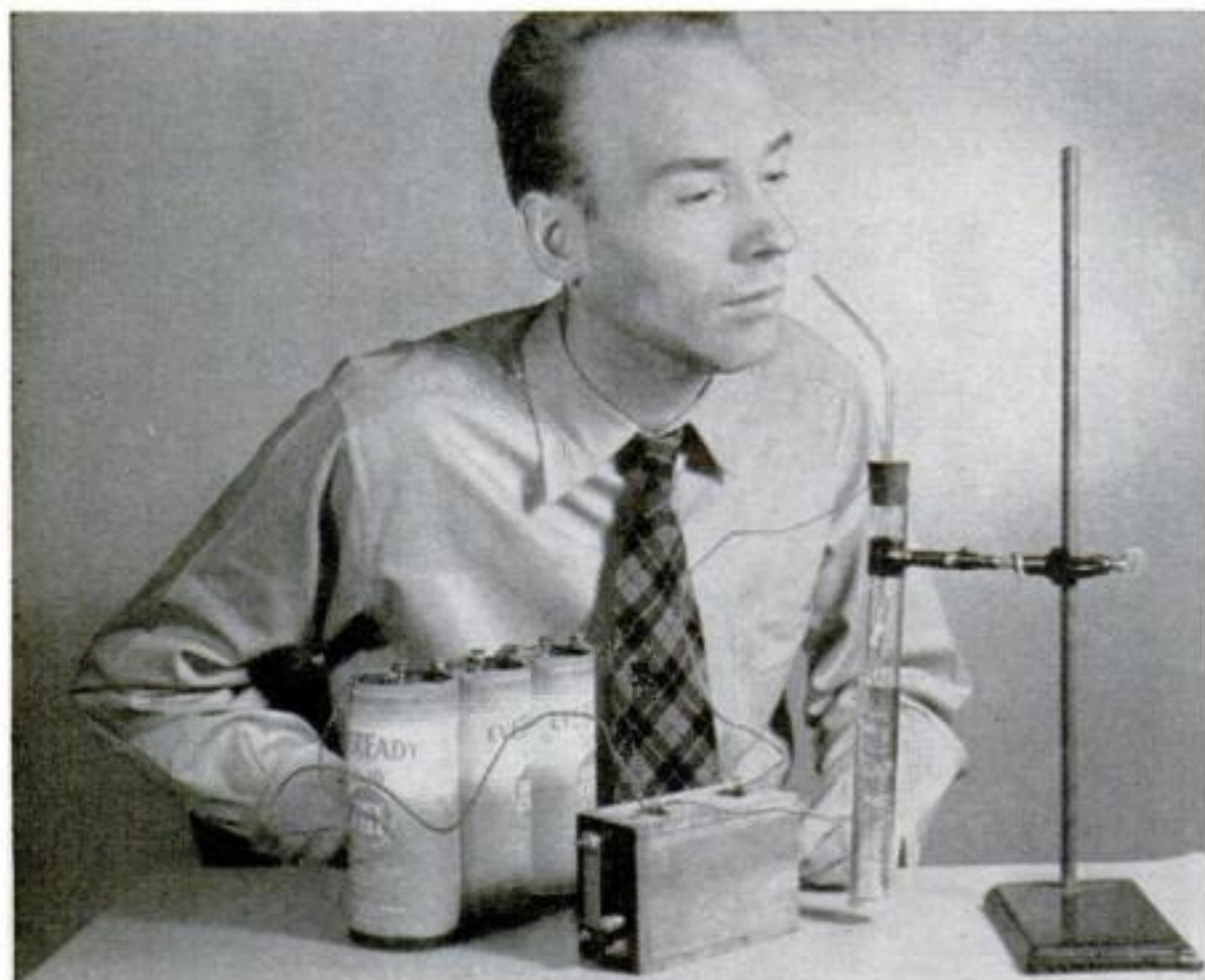


Fig. 4

SCIENCE TUNTS

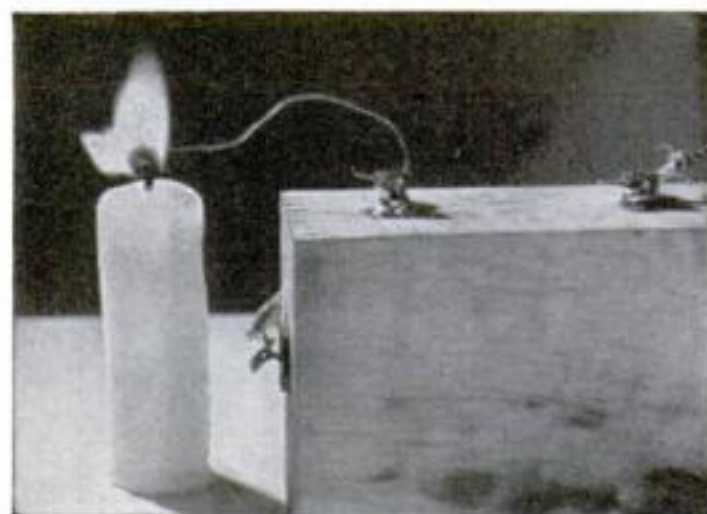
TESTS WITH ELECTRICITY

INTERESTING electrical experiments are possible with either a spark coil from a Model-T Ford or a small neon-sign transformer. On the Ford coil, the end terminal is one of the primary terminals, and the top terminal nearest the end-terminal end is used jointly for the other primary terminal and the inner terminal of the secondary. To help prevent a shock, connect this secondary terminal to your apparatus.



OZONE GENERATOR. Ozone, a form of oxygen that smells like weak chlorine, may be easily generated with the spark coil. Coat the outside of a glass tube with tin foil, as shown, and connect this to one secondary terminal. Connect the other secondary to a piece of tin foil inside the tube. Stop up the tube bottom, and put a one-hole stopper with a smelling tube in the upper end. Current will cause a pale violet discharge, changing some oxygen of the air into its allotropic form of ozone.

ELECTRO-COATING, as in sandpaper making, is demonstrated with cigarette ashes on a piece of paper. Set the paper on a metal plate connected to one secondary terminal of the coil or transformer. Bend the other secondary wire to resemble a grid, and hold it over the ashes just beyond sparking distance. The ashes will dance around when current is turned on. By holding another piece of paper covered with glue over the ashes, some of the ashes will jump up and be embedded in the glue.

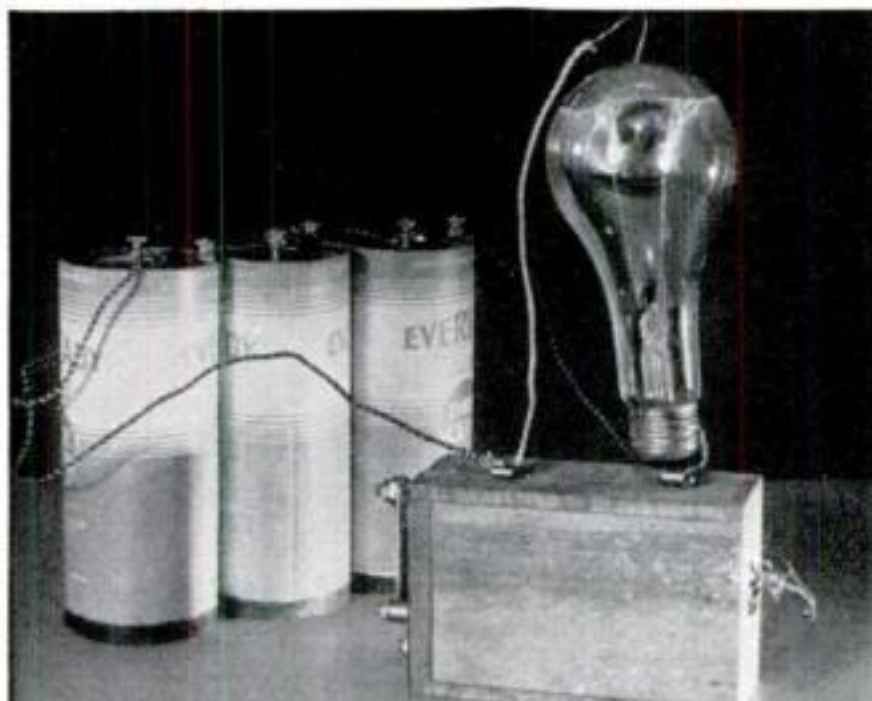


INVISIBLE DISCHARGE. Lead a wire from the high-potential terminal of your spark coil to a candle flame, and the flame will be blown mysteriously when current is on. The cause of this is accumulated electricity of such high intensity at one terminal that some escapes right off the point in the form of electrified air particles. To prevent such leakage, the terminals of most high-potential generators and machines are ball-shaped instead of pointed.

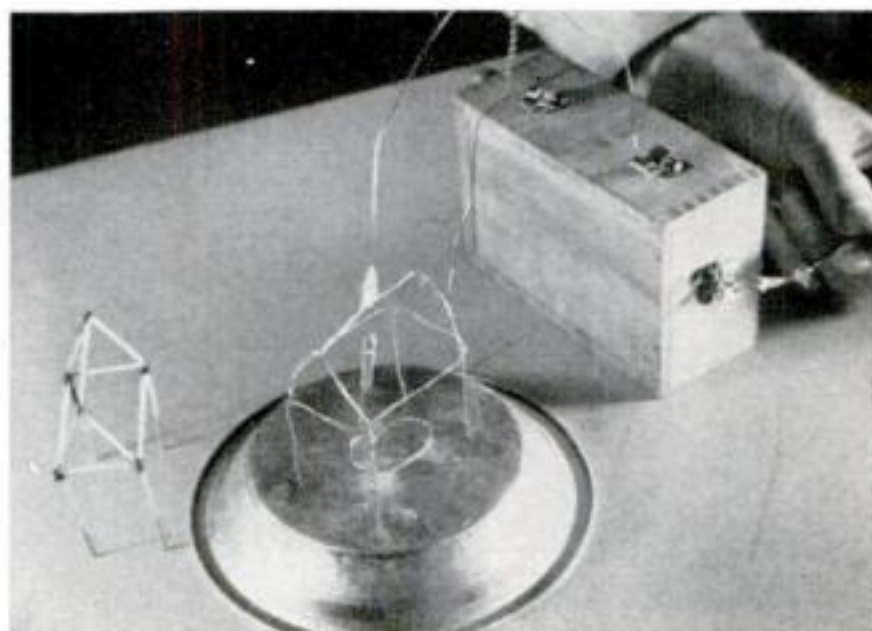


BALL TERMINALS connected to the secondary wires will produce only a short, thin spark, compared with that obtained from needle-sharp terminals. For with a ball, the current is spread over a large surface and lacks concentration such as occurs at a needle point. Keep increasing the size of the balls and the spark that it will be possible to produce will keep getting shorter and heavier, until practically no spark can be induced to jump the gap.

A FLUORESCENT-LIGHT EFFECT may be demonstrated by connecting one high-tension wire to a cap of tin foil glued over a burned-out lamp bulb, as shown, and the other to both terminals at the bulb base. Streamers of violet-colored electric discharge—miniature bolts of lightning—will jump between the bulb filament and the tin foil when the current is turned on.



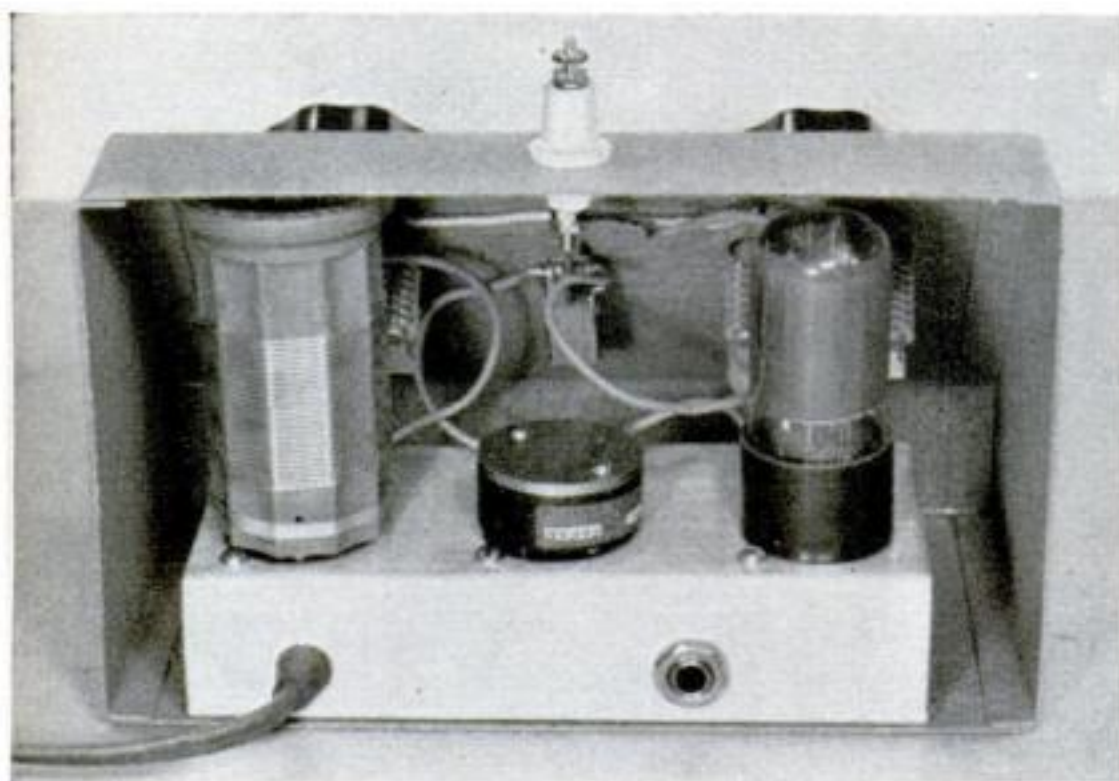
GLASS conducts electricity poorly, yet heat the tip of a glass rod very hot and hold it just below your spark gap, and your spark will jump twice as far as usual. Remove the rod and the spark stops. Let the rod cool and it will have no effect. The reaction comes because heat ionizes the air in the spark gap, improving its conductivity to the point where a much longer electrical jump is made possible. This little experiment makes a good stunt for mystifying your friends.



LIGHTNING ARRESTER. Build wire and wood houses, as shown, and direct "lightning bolts" at them in turn. A match supported head-up in the metal house is protected by the wire, which leads the high-tension current away. But in the wooden house, the spark strikes the match and ignites it, setting fire to the house. The test shows how buildings with metal frames are safer in electrical storms. The more "grounded" metal that surrounds you, the safer you are.

Two-way Radio Station

COSTS \$18 TO BUILD

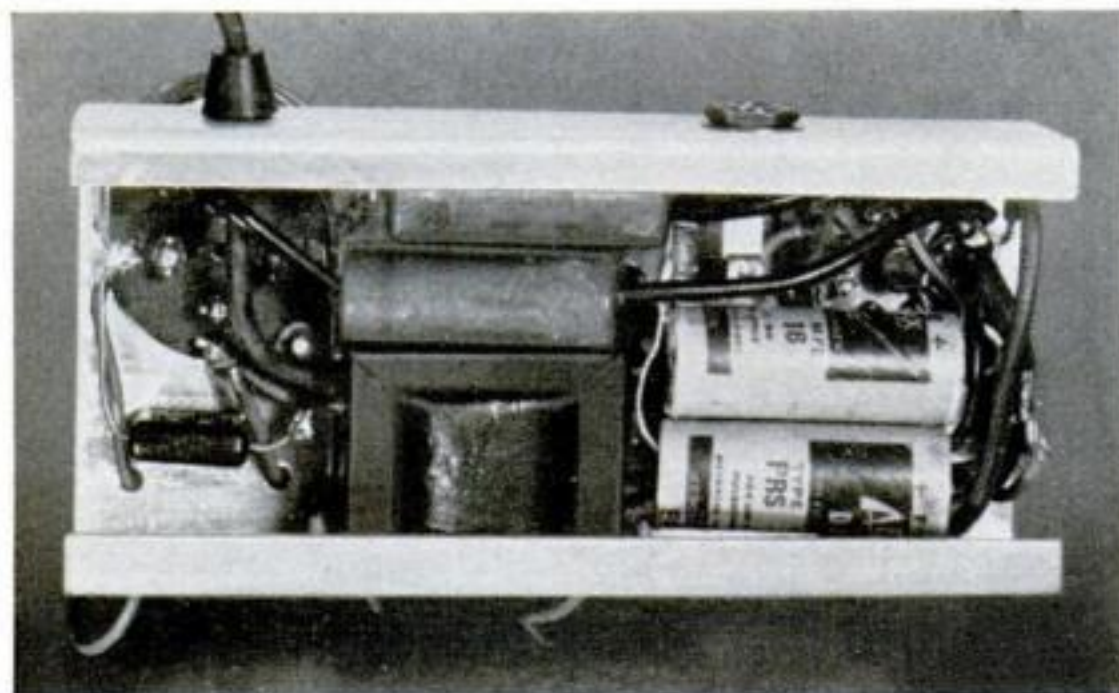


Adjusting the midget transmitter described in this article. Left, the receiver, and right, the sending key

By **ARTHUR C. MILLER**

FOR the amateurs specially authorized by the Government to use transmitters for specified emergencies, a complete sending and receiving station is detailed on these pages. Inexpensive and compact, as well as easy to build, the efficient short-wave receiver and "punchy" little transmitter will provide an excellent stand-by station in case of trouble in regular equipment.

A choice of two circuits is given for the receiver. As a straight one-tube plus rectifier tube, the set will pull in South American stations and several amateurs—final results depending, of course, on the locality and position of the antenna. As a two-tube plus



On the transmitter chassis, left, are a four-prong 80-meter plug-in coil, crystal, and 117N7GT tube. Shown in the view from underneath are the filter choke, two 16-mfd. electrolytic and two paper tubular condensers

the rectifier, it should bring in the European stations and several more amateurs in the United States and possibly South America.

A few simple alterations change the receiver to a three-tube set, so we will describe only the two-tube version. This circuit calls for a 6J7 as a pentode detector and a 25Z6 as a half-wave rectifier. Both tubes are metal and require no external shielding. A six-prong coil is used and on it are three windings—a primary or antenna, a secondary or grid, and a tickler winding.

There are two antenna connections at the back of the chassis—one leading straight to the primary winding, the other through a .0001-mfd. mica condenser to the grid winding. The first is used when an outside antenna longer than 50' is employed, while the other is for short indoor antennas up to 30' or 40'. Tuning is accomplished with the .00014-mfd. condenser (the small dial to the left of the center dial in photo). When a band such as the 80-meter amateur band is tuned in, it is spread out over a 180-deg. arc by means of the band-spread condenser (the large center dial). This system aids tuning on short waves.

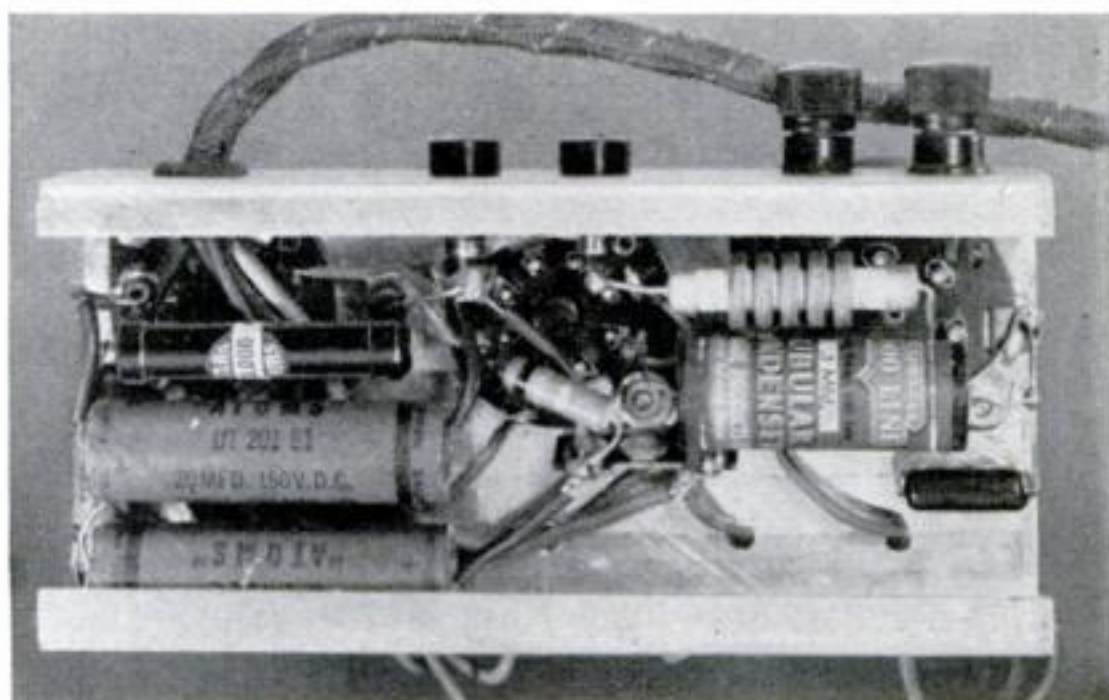
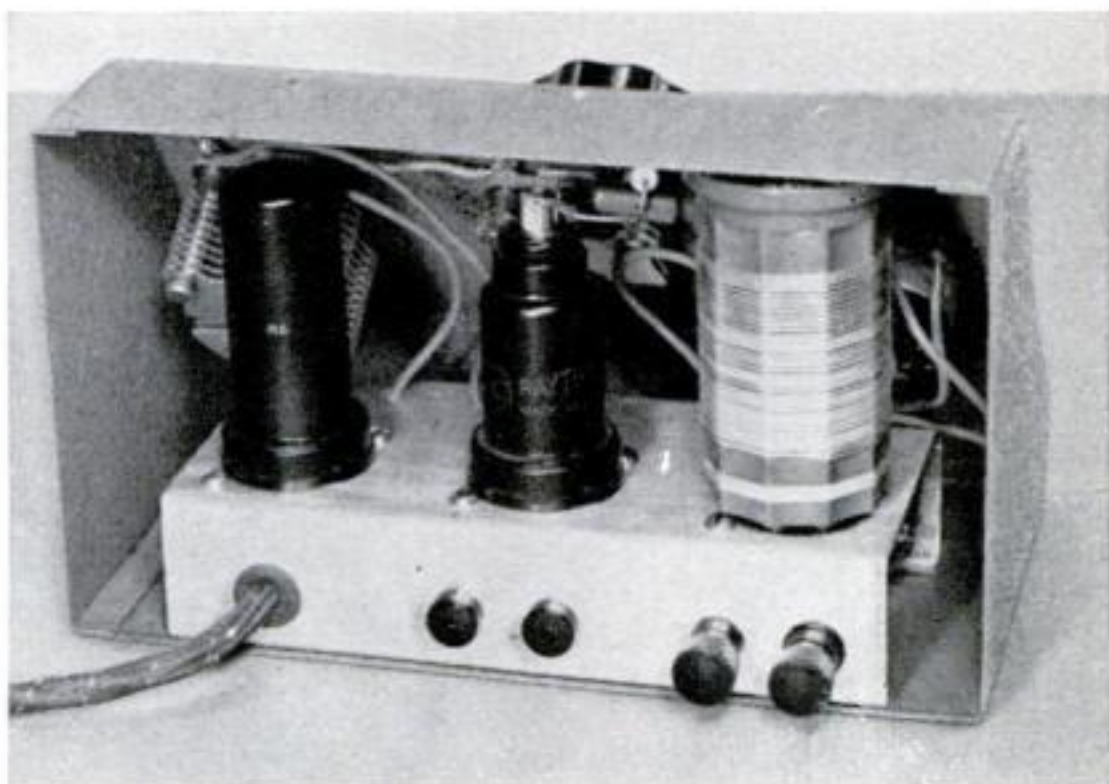
Regeneration is controlled by the 50,000-ohm variable resistor in the screen circuit of the 6J7. This type of regeneration is extremely smooth and eliminates the loud "plop" as the receiver goes into oscillation. Any type of magnetic phones may be used if the resistance is between 2,000 and 4,000 ohms.

Ample filtering is provided by the 20,000-ohm, 5-watt wire-wound resistor and the two 20-mfd. electrolytic condensers. No hum should be heard, even at the point of oscillation, but if it is, try increasing the .01-mfd. tubular condenser in the plate circuit of the rectifier (25Z6) to about .1 mfd.

The transmitter uses the new 117N7GT, which is a combined power pentode and rectifier tube. It has a 117-volt heater, does not need a

line-cord resistor, and operates directly off a 115-volt AC or DC line. Tuning is done with the .0001-mfd. variable condenser across the four-prong plug-in coil. The antenna coupling is adjusted by the other .0001-mfd. variable condenser in the antenna lead. A crystal in the grid circuit of the pentode stabilizes the signal and prevents transmitter drift. The key is inserted in the cathode and by-passed by a .1-mfd. tubular condenser. Another .1-mfd. tubular condenser across the 115-volt line smooths out any remaining "ripple" in the signal sent.

Tuning a transmitter correctly involves patience, but can be done easily with the aid of a 0-50 milliammeter. With the antenna disconnected and both variable condensers in mesh, the 0-50 milliammeter (which is connected across the key terminals) should read 35 milliamperes. Gradual reduction of the capacity of the tank or tuning condenser will dip the needle to about 18 milliamperes. Further reduction will cause the needle to jump back to about 23 milliamperes and stop there. Regulate the tuning condenser so that it reads about



Amateur-band tuning is done with the coil (right) on the receiver chassis. The tubes are 6J7 and 25Z6. Above the two electrolytic condensers, at left in the bottom view, is the wire-wound resistor. The RF choke is shown at right

LISTS OF PARTS

TRANSMITTER

Cabinet, 7½" by 4½" by 4¼".
 Four-prong 80-meter plug-in coil.
 Rubber line cord and plug.
 Octal wafer socket.
 Four-prong wafer socket.
 Mounted crystal, 80 meters.
 Five-prong socket for crystal.
 Pentode-rectifier tube, 117N7GT.
 Filter choke, 12 Henrys, 250 ohms.
 Toggle switch, S. P. S. T.
 Condensers: Mica, .001 mfd.; electrolytic (2), 16 mfd., 150 volts; paper tubular (2), .1 mfd., 600 volts; tuning (2), .0001 mfd.
 Carbon resistor, ½ watt, 50,000 ohm.
 Ceramic antenna binding post.
 Transmitting key.

RECEIVER

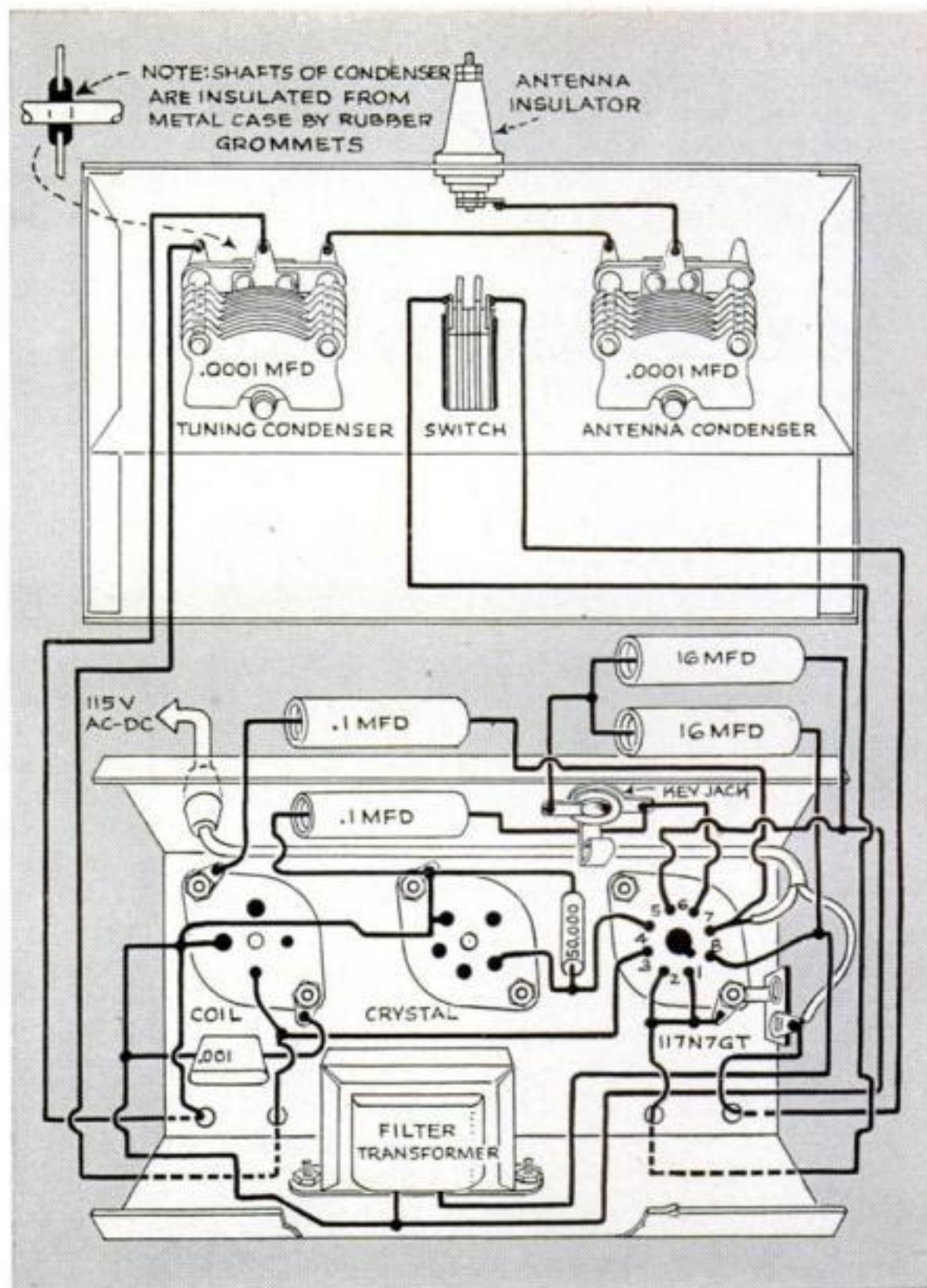
Cabinet, 7½" by 4½" by 4¼".
 Six-prong 80-meter plug-in coil.
 Midget RF choke, 2.5 millihenrys.
 Resistor line cord, 290 ohms.
 Octal wafer sockets (two).
 Six-prong wafer socket.
 6J7 triple-grid detector tube.
 25Z6 half-wave rectifier.
 Variable resistor, 50,000 ohms.
 Attachable switch, S. P. S. T.
 Condensers: Electrolytic (2), 20 mfd., 150 volts; mica (3), .0001 mfd., .00025 mfd., and .0002 mfd.; tubular paper (2), .1 mfd., 600 volts, and .01 mfd., 600 volts; tuning (2), .00014 and .00002 mfd.
 Resistors: Carbon (2), 100,000 ohms, ½ watt, and 1 megohm, ½ watt; wire-wound, 20,000 ohms, 5 watts.

EXTRAS FOR THREE-TUBE RECEIVER

Resistor line cord, 260 ohms.
 Pentode-rectifier tube, 32L7GT.
 Condensers: Electrolytic, 5 mfd., 25 volts; paper tubular (2), .002 mfd., 600 volts, and .05 mfd., 600 volts.
 Resistors: Carbon (3), 1 watt, 600 ohms; ½ watt, 500,000 ohms, and ½ watt, 250,000 ohms.

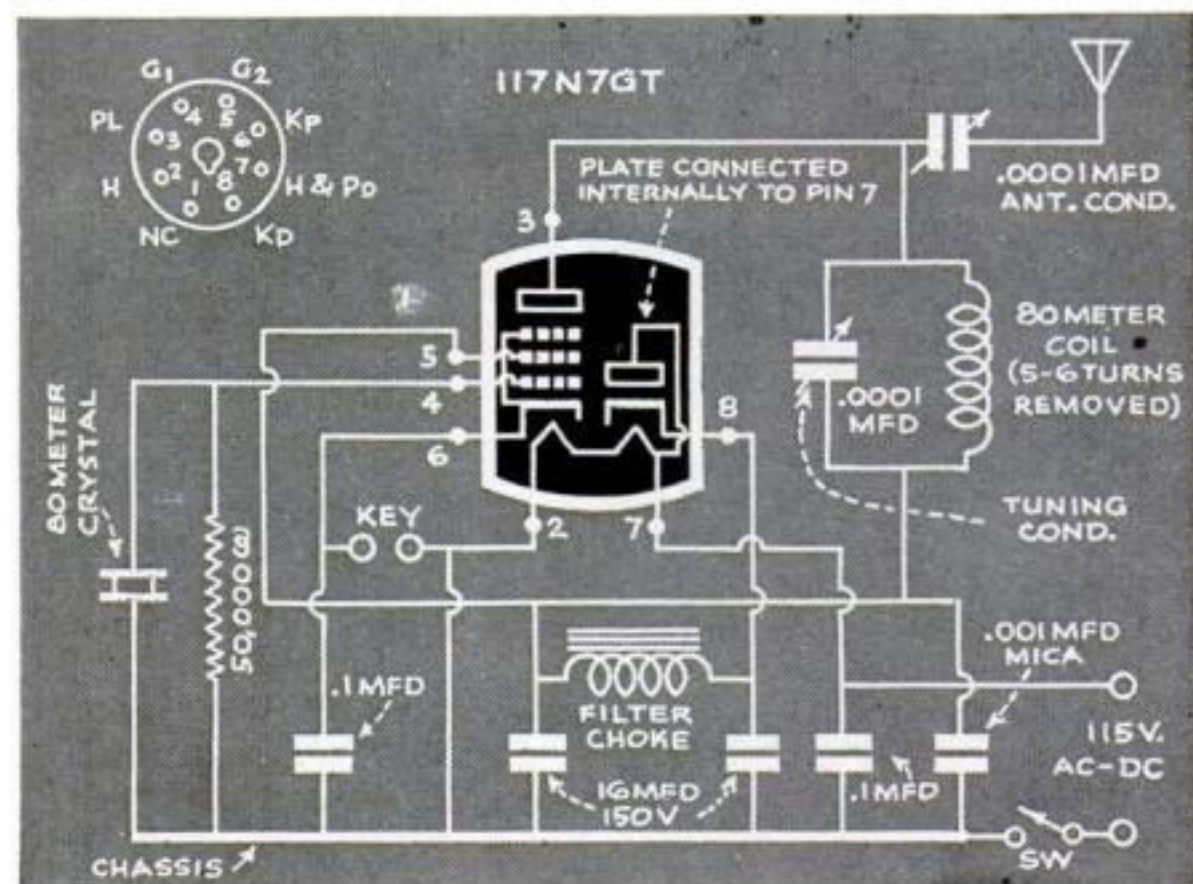
20 milliamperes or at a degree on the dial where it is slightly more out of mesh than at the maximum dip of the needle.

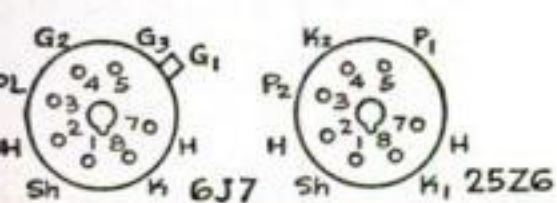
Now connect the antenna. The needle will instantly jump back to 35 milliamperes. Turn this time the antenna condenser until the needle dips to about 30 milliamperes. Turning the condenser further out of mesh will cause the needle to dip to about 25 milliamperes. However, the antenna is correctly loaded at the 30 milliampere reading, so turn the condenser back until the reading is again 30 milliamperes.



Pictorial diagram of the midget radio transmitter using the new 117N7GT combination power pentode and rectifier tube

Below, complete wiring diagram of the transmitter. About 3 watts are fed into the antenna by this little sending outfit



[illegible]

Cabinet Detail

Cabinet
Detail

Transmitter
Chassis

Receiver
Chassis

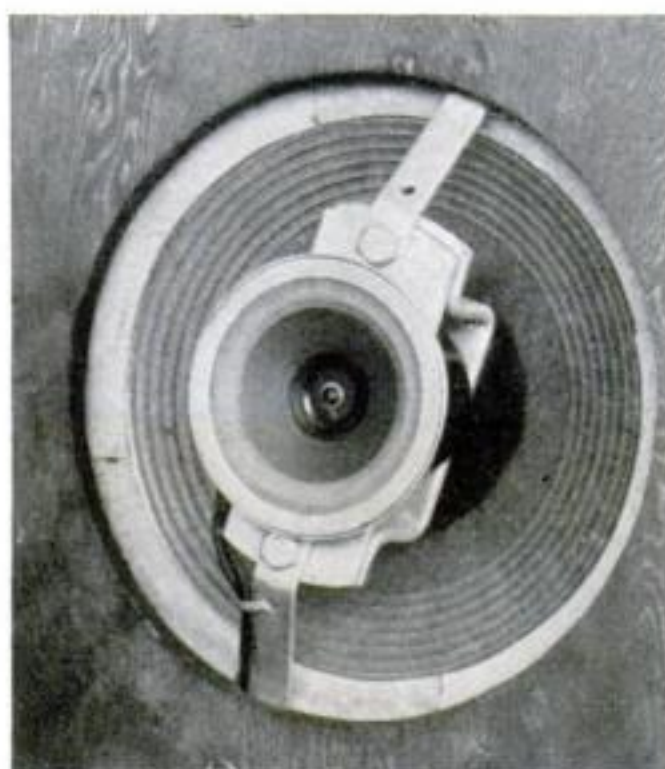
Radio Ideas

CACTUS PHONOGRAPH NEEDLES can be sharpened by a disk that fits on a turntable and acts as an emery wheel. The needle itself is supported by a novel holder which rotates as the disk turns. A small plastic wheel, which rests on the turntable, keeps the needle at the proper angle. The other side of the disk has a polishing surface.



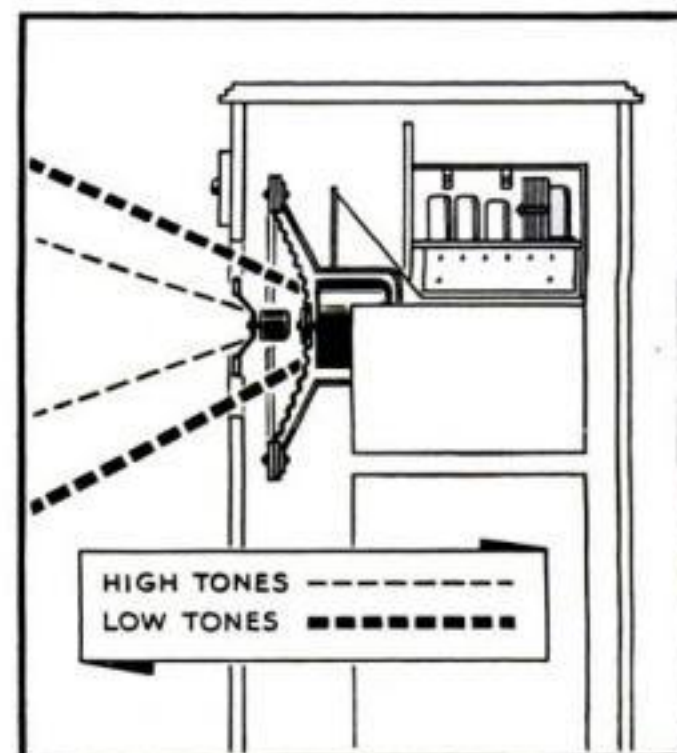
BASE AND TREBLE SOUNDS of the "woofer" and "tweeter," the low- and high-frequency speakers used in FM reception, have been brought together neatly in a new coaxial arrangement. This consists in placing the tweeter, reduced to a diameter of two and a half inches, in front of a shallow, eight-inch bass cone in such a way that the full audio band of 50 to 15,000 cycles is reproduced as one voice. The back of the small cone is enclosed, confining air which forms an elastic element in the resonant vibrating system. This serves the double purpose of stepping up the response of the small cone in its lower-frequency range and protecting its delicate mechanism from the powerful radiations of the bass speaker. The smallness of the tweeter as compared

with the wave lengths of its high-frequency sounds eliminates a directional tendency, spreading the sounds through a comparatively wide arc for the benefit of listeners not seated immediately in front of the speaker.



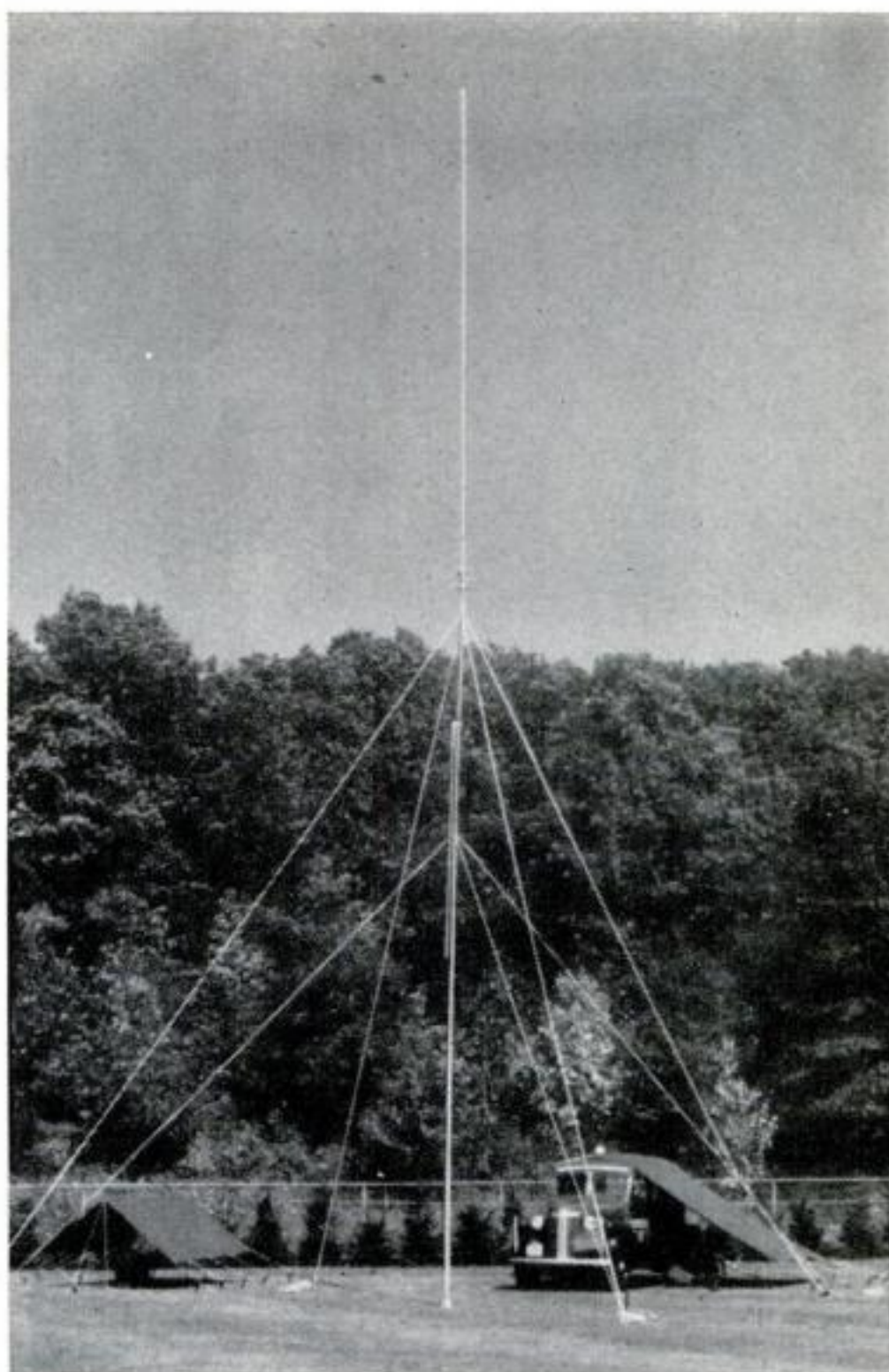
Cushioned in front of the large bass speaker, the delicate high-frequency FM cone blends in its treble voice

Radiation of high frequencies both vertically and horizontally lends "presence" to the sound



ELECTRONS ARE BOUNCED in nine successive stages inside the phototube at left before they reach the final anode. This amplifies the photocurrent produced at the light-sensitive cathode 230,000 times, sufficient to measure the light from stars. Electrons emitted from the illuminated photocathode are directed by fixed electrostatic fields along curved paths to the first dynode (secondary emitter), impinging on the dynode surface and producing more electrons. The secondary electrons are directed to a second dynode, freeing new electrons. This process is repeated in each successive stage until the electrons from the last dynode are collected by the anode to constitute the current in the output circuit.

A COLLAPSIBLE ANTENNA is used by the New England Telephone Company for radio transmission in connection with its emergency telephone service. It is 60 feet in height, but may be folded up and stowed away in a steel drawer in a fast, light truck. The antenna can be set up quickly, and held securely in place with several guy ropes. A 50-watt phone transmitter, when used with the antenna, has a range of 40 miles and operates on a frequency of 2,726 kilocycles. The truck, built on the lines of a station wagon, carries in addition to the collapsible antenna and the phone transmitter, a gasoline power generator, a radio receiver, a large box of tools, a telephone control unit, and a canvas tent which can be pitched near-by to protect the generator and other equipment while it is in operation.



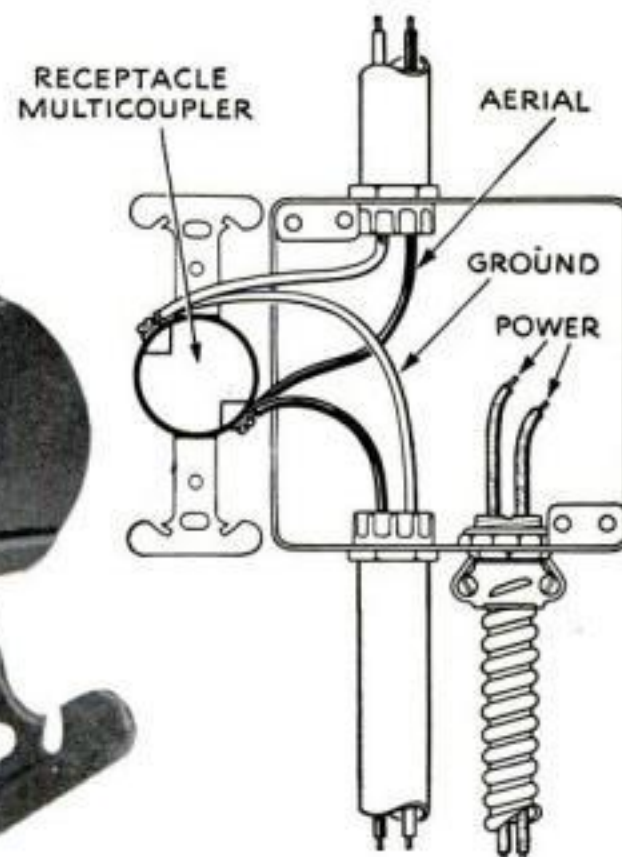
Set up for emergency transmission, the antenna above has been rushed to the scene in the truck beside it

Folded, at left, it fits into a drawer in the truck, which is equipped also with a two-way radio outfit

A NEW ANTENNA WALL PLUG for apartment houses may be used with FM receivers as well as regular broadcast or short-wave sets. It employs an aerial consisting of two wires—one 45 feet long and the other 15—which are supported by angle-iron masts on the roof of the building. Up to 20 plugs may be served with a single aerial and transmission line. The coupler unit is provided with a built-in polarized outlet that fits the standard wall-plug face plate. When the radio is attached, the antenna and ground are automatically connected to the proper posts on the plug, which make the outlet available for broadcast, short-wave, or FM reception.



Wall-plug unit of a multicoupler antenna system, with connections shown at right





REFLECTORS PUT SUNLIGHT WHERE IT DOES MOST GOOD, and two do more good sometimes than one, as above, where the cameraman has placed them on the ground and raised his camera to a high angle in order to get the interesting picture of Faith Dorn, Hollywood actress, on the facing page. He is using gilt-painted reflectors, which give a warm light, akin to the effect of a yellow filter. Note how they relieve the shadows and high light the shaded side of the subject. Well known in Hollywood, they are as easily used—and made—by the amateur photographer for either movies or stills, and go far to improve the lighting of outdoor shots

Synchronized Sunlight

PUTS LIFE INTO YOUR PICTURES

By Tony Gaudio, A.S.C.

PROFESSIONAL photographers, especially the press boys who must grab 'em on the run, take many pictures with synchronized flashes. Thousands of amateurs are trying their hands at synchronized lighting, and successfully, too.

But you can't synchronize a single bulb to the shutter of a movie camera, because you will illuminate the scene for only one frame. Floods and spots solve the problem indoors, but how may you soften the shadows, provide rim lighting, and cast lively back lighting when working outdoors?

For both movies and stills, reflectors which catch the sunlight and bounce it back where it will do the most good are the answer. With them you can achieve modeling and therefore obtain lovely, well-rounded pictures that would generally be impossible under direct natural light alone.

Forty-eight years ago Tony Gaudio made his first photographic enlargements in his brother's studio. Eleven years later, when only 20, he became a full-fledged motion-picture cameraman, grinding out a 500' feature every working day. He has filmed nearly 1,000, including such top-flight pictures as "The Fighting Sixty-ninth," "The Letter," "The Great Lie," and "The Man Who Came to Dinner." Always experimenting, he is trying to design a convex reflector that will distribute light with greater uniformity than flat surfaces.

To be effective, the "sunlight synchronizer" requires two qualities: Size and reflection. Except for extreme close-ups, the reflector should be no smaller than 36" by 36". A bed sheet may be used, or any other surface that will reflect light, with one excep-





Adjusting his reflectors, the author seeks the right lighting for a picture of Elisabeth Fraser, young Warner Brothers actress, who posed especially for **POPULAR SCIENCE** in the accompanying series

tion: don't use mirrors. They reflect a sharp beam, giving an unnatural effect.

Anyone can make in an hour or so the type reflectors the cinematographers in Hollywood employ. Get four pieces of plywood 18" by 36" and $\frac{1}{4}$ " thick. Hinge a pair of these so they fold like a book, placing the hinges about 6" from the outer edges. Fasten rubber stops near the outer corners of one. Cut a leather dog leash into four equal parts, and with staples tack one to each side—they make excellent handles for carrying the reflector like a suitcase.

How shall you coat the surfaces? This depends upon the effect desired. If you want a "hard" reflector, cement sheets of tinfoil, carefully flattened to avoid wrinkles, to the plywood. This surface will kick sunlight into shadows like the beams from a spotlight. Tinfoil saved when you unwrap film, cigarettes, or candy bars will serve the purpose well and at no cost.

Softer, more diffused beams will be reflected by surfaces coated with gilt or aluminum paint. Aluminum (or silver) provides a clear, white light, like natural daylight, and is preferred for color film. Gold throws

Miss Fraser faces directly into the sun, with rim and back lighting from silver and gold reflectors



back a warm light, the effect of which is much the same as that of a yellow filter. Gold is easy on the eyes, and many prefer this surface for black-and-white photography, both still and movie, but it is not suitable for color film.

At the extreme range of "softness," flat matte-white paint provides a coating which gently lightens the shadows without being so obvious as the harder surfaces.

Someone in the family may be willing to hold a reflector long enough for a still; but when "setting the lights" and supporting the reflector for a movie sequence, you will need a stand—one heavy enough to resist falling over when breezes blow.

The parts for a professional-looking stand are available at plumbing shops. Into each end of a $\frac{3}{4}$ " pipe tee, screw a 12" length of $\frac{3}{4}$ " galvanized pipe, and screw a tee on the other end of each. Into these two tees, screw additional 12" lengths of pipe, forming an "H," and on each of the four ends place a pipe elbow to serve as the foot. At the center of the crossbar, screw a 36" length of $\frac{3}{4}$ " pipe into the remaining joint of the original tee. Add a coupling at the top, if desired, and drill and tap to take a set screw or wing bolt, completing the base. For the top, attach a tee or a cap to the end of a 48" length of either $\frac{3}{8}$ " galvanized pipe or a metal rod that will telescope into the $\frac{3}{4}$ " pipe, and bolt or weld across the top a strong piece of strap iron about 75" long, bent U-shaped to clear the reflector by about $\frac{1}{2}$ " on

each side. Drill and tap the ends for small wing-bolt clamps.

Now that you have your reflector, how shall you use it?

As a general rule, do not cast the reflected light upward. Remember, you are using sunlight, therefore the secondary illumination should strike shaded portions of the subject from approximately the same angles, though not from the same direction. Natural light always comes from above, and lighting from below, except for special effects, is likely to give an unnatural effect. Use reflectors ordinarily in these four situations:

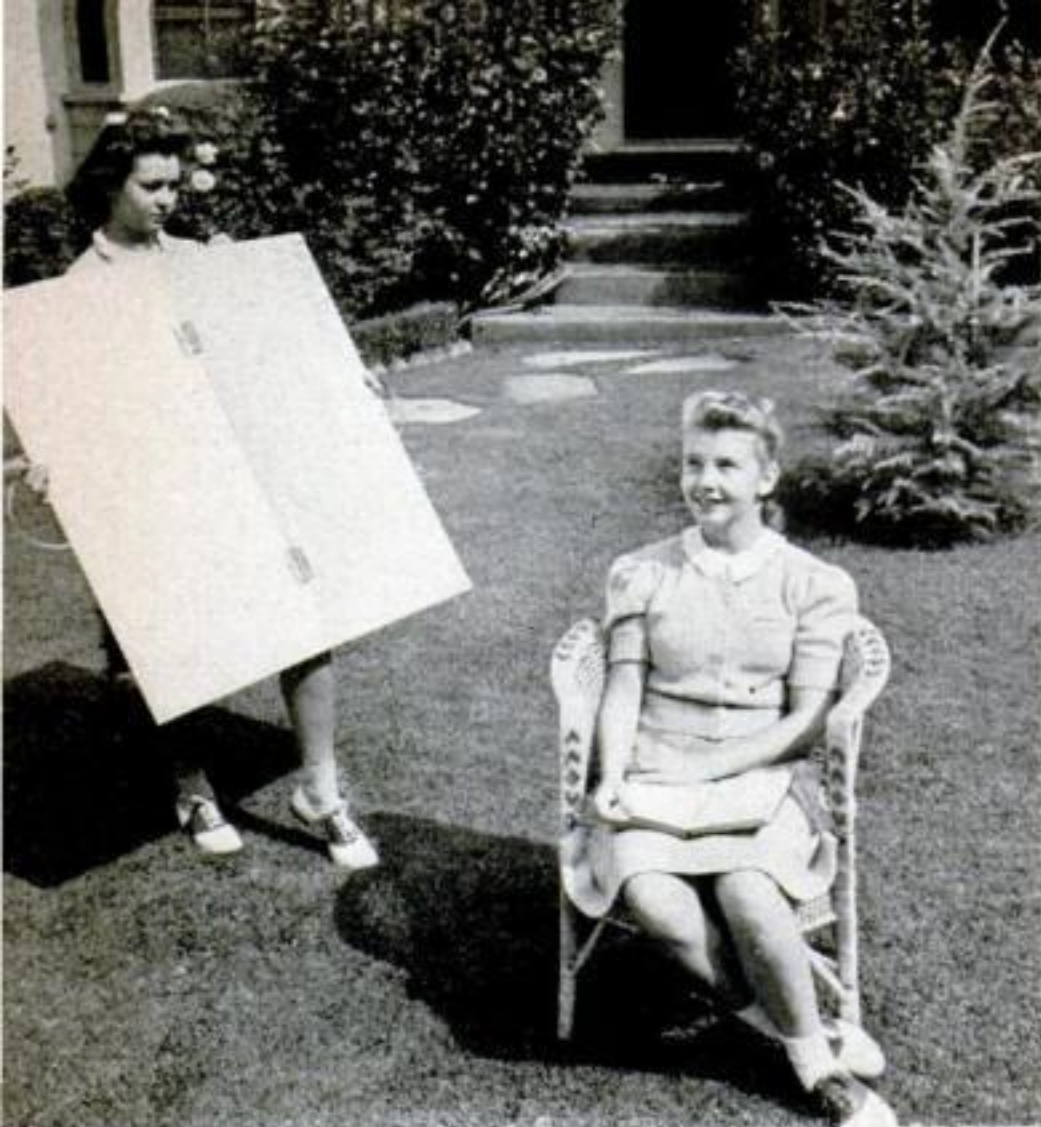
Cross light. You're aiming for the face, of course, and lightening the shaded side in a cross light offers the simplest use for the device. It is usually a good plan to hold the reflector about face high, moving in or away to get the desired illumination. By placing the reflector to the rear and side of the subject, you'll produce detailed shadows, not heavy ones that will die from underexposure. By experimenting, you can determine the exact angle at which to cast the light. If your subject is bareheaded, you can hold the reflector higher than when he is wearing a hat, in which case you must lower the reflector to get the beams in where they will do some good.

Back lighting. The same methods apply here, with one exception. Two reflectors will be needed, one for each side of the face. Bring one in closer than the other to increase the light on that side. This will yield a fine

In cross light, a single gold reflector placed to the rear and side relieves shadow and adds detail



Back to sun. A silver reflector gives key light on the left of the face; a gold one fills shadow



Except for the lowest shots, reflectors should be at a level with the face to duplicate the natural effect of sunlight, which always comes from above

effect of modeling. Instead of using a silver reflector on one side and a gold or matte-white on the other, I usually unbalance the lighting with two of the same type, one placed at a greater distance. A hard silver surface sends back a much stronger beam which usually gives an unpleasant effect.

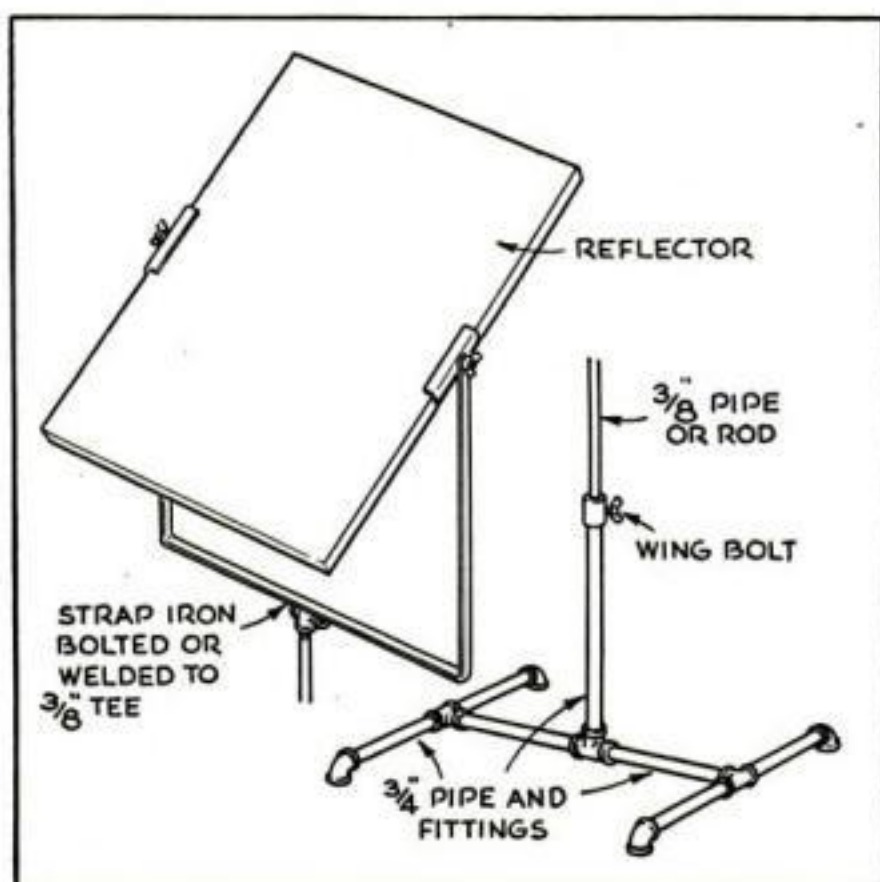
All shade. Suppose characters are under the thick branches of a tree, or on a covered porch. In Hollywood, we place reflectors in the sun at an angle that will bend the beams toward the subject. Here is a case where the hard type may be more effective, because its beams tend to follow a searchlight path and carry farther.

Rim lighting. Back lighting and rim lighting may be combined. The near-noon sun will provide high back lighting, as in one photograph on page 209. A silver reflector (hard) on the left side of the subject's face rim-lights it with a strong beam. A gold reflector (soft) lightens the shadows on her right. The soft reflector is placed a little farther back than the hard one. Together, the sun and two reflectors enabled the photographer to get a well-balanced picture.

Often you find your subject facing directly into the sun. Here you have a flat front lighting, which, unless you use a little ingenuity, gives you exactly that sort of picture—flat and dull. If you place a hard reflector directly back of the subject, you'll get rim lighting to relieve the monotony. Should it be in the picture, move it out slightly to one side, placing a second on the opposite side. Their beams, converging on



Leather straps fastened at the edge enable you to carry a folding plywood reflector like a suitcase



Professional-looking reflector stand made of pipe fittings, which can be obtained at a plumbing shop

the subject's head, will give a lively effect.

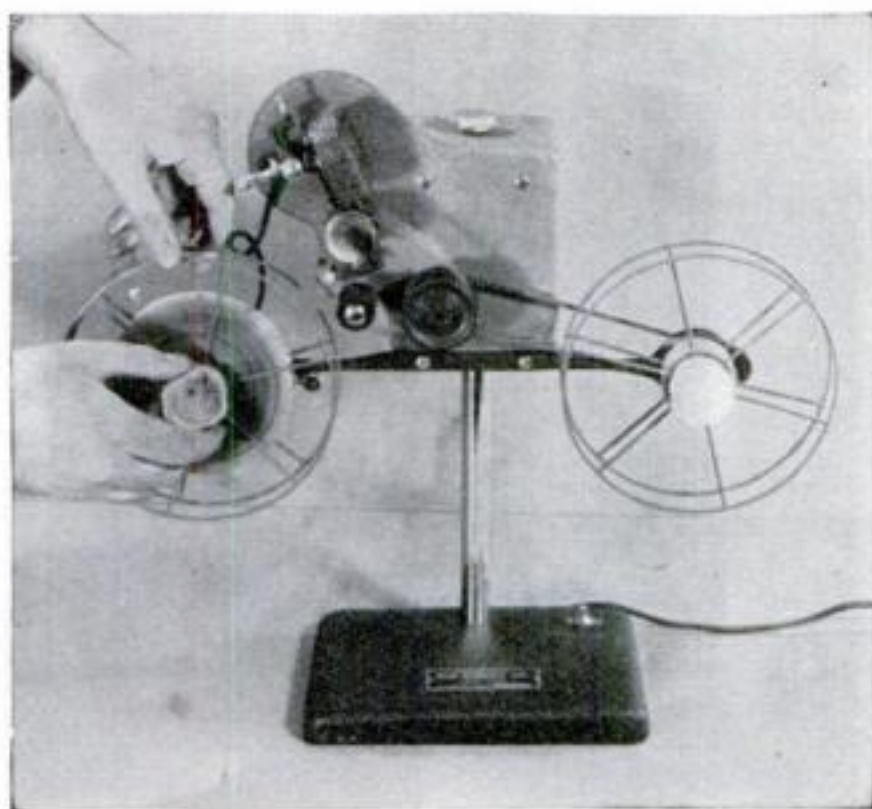
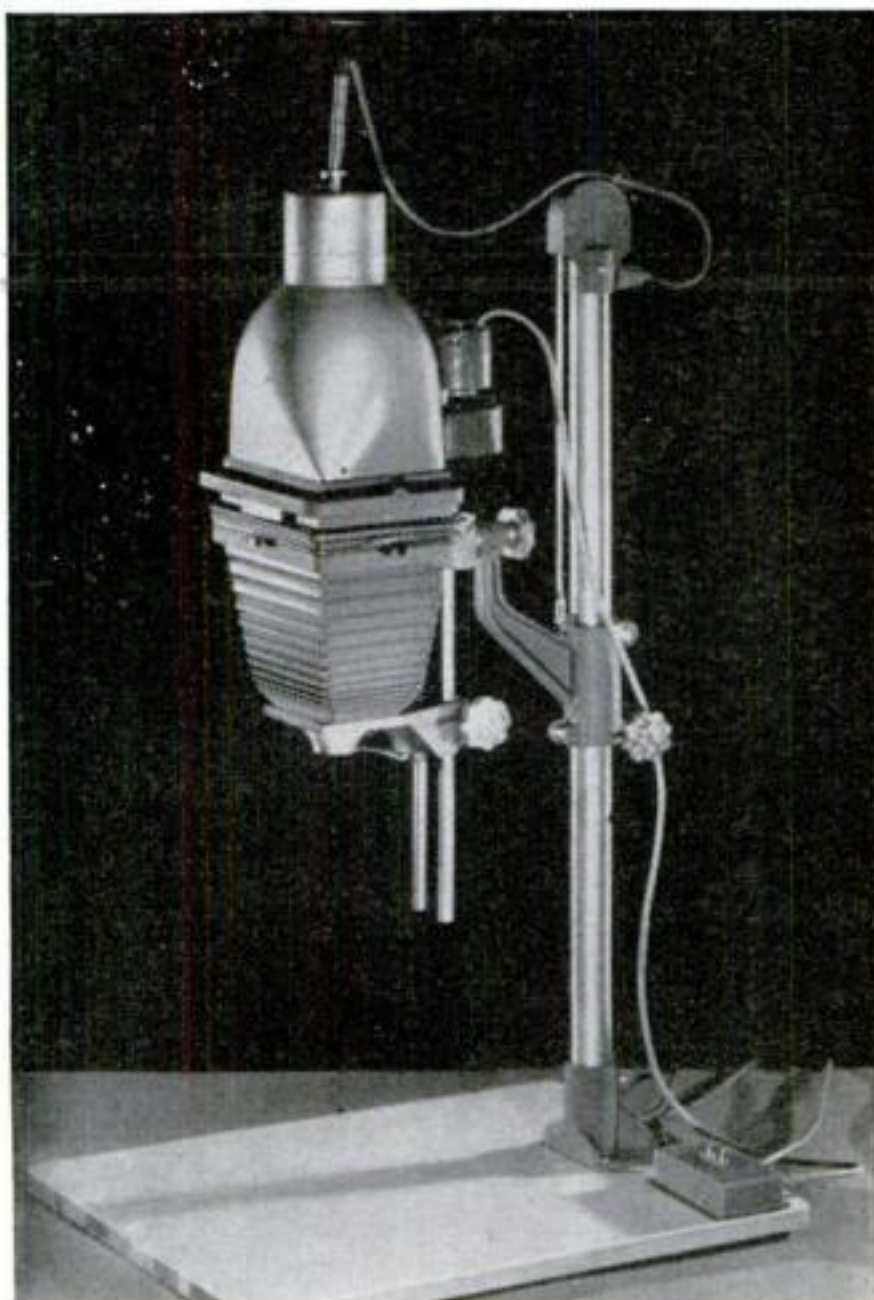
After setting your reflectors, how shall you plan your exposure? This is not difficult. Follow that tried and true rule—"Expose for the shadows, and the high lights will take care of themselves"—or take a meter reading of the reflected light.

This is a good method: Arrange the reflector to get about 50 percent as much light on the shadow side as the sun delivers on the bright side. When using a meter, take separate readings, holding it close enough to the face to cover only the required field. If the meter shows the shadow side too "hot," move the reflector away.

If you don't want to bother about such details, simply take an overall reading. You'll be surprised by the excellence of your pictures once you synchronize Old Sol's indirect rays to those streaming directly down.

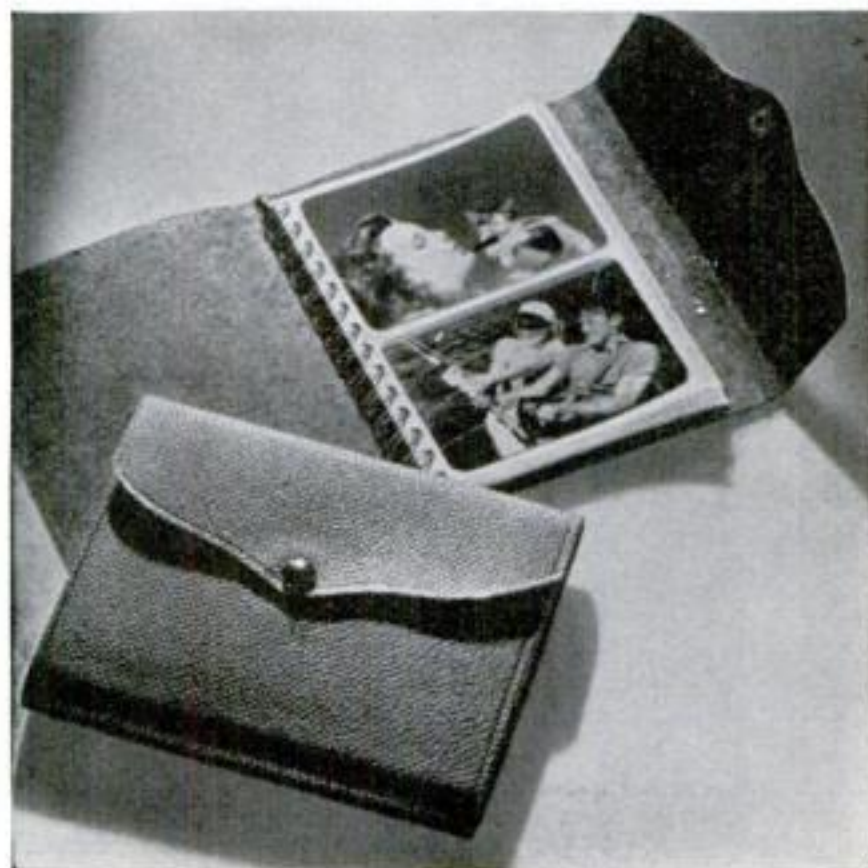
FOR CAMERA USERS

HAVING A POWER-COOLED LAMP HOUSE, this enlarger, which takes negatives up to 4" by 5½" and makes prints up to 11" by 14", can be used with the high-wattage No. 213 Mazda photo enlarger lamp instead of the regularly supplied No. 212, thus increasing its speed about two and a half times. Cool air is circulated between the heat-absorbing glass and the opal diffusing glass without passing directly above the negative. The head may be turned 180 deg. around its column or from vertical to horizontal. Three lenses—Kodak 5" (128 mm.) projection anastigmat f/6.3, 5⅝" (135 mm.) f/4.5, and 6⅜" (161 mm.) f/4.5—are available.



SOUND RECORDING for home movies is facilitated by the use of the new sound-on-ribbon reproducer shown above, which may be used with the amplifier and speaker of any good radio. The sound track is embossed on a special transparent film, available in 500' to 2,000' reels, or directly on the picture film if the projector is 16 mm. Twenty-eight sound tracks can be embossed across the width of the special 16-mm. film, and each track of 500' runs for 20 minutes, giving a total of 9 hours, 20 minutes.

POCKET FOLDERS AND ALBUMS are now available for the new 2¼" by 3¼" Minicolor prints. One type of pocket folder, of simulated leather, holds one, two, or three prints. Another of similar size has a fold-over flap and glove-button fastener. A wire-bound album, shown below, has a capacity of 24 prints, four in each of six transparent envelopes with gummed leaves to accommodate them mounted back to back.



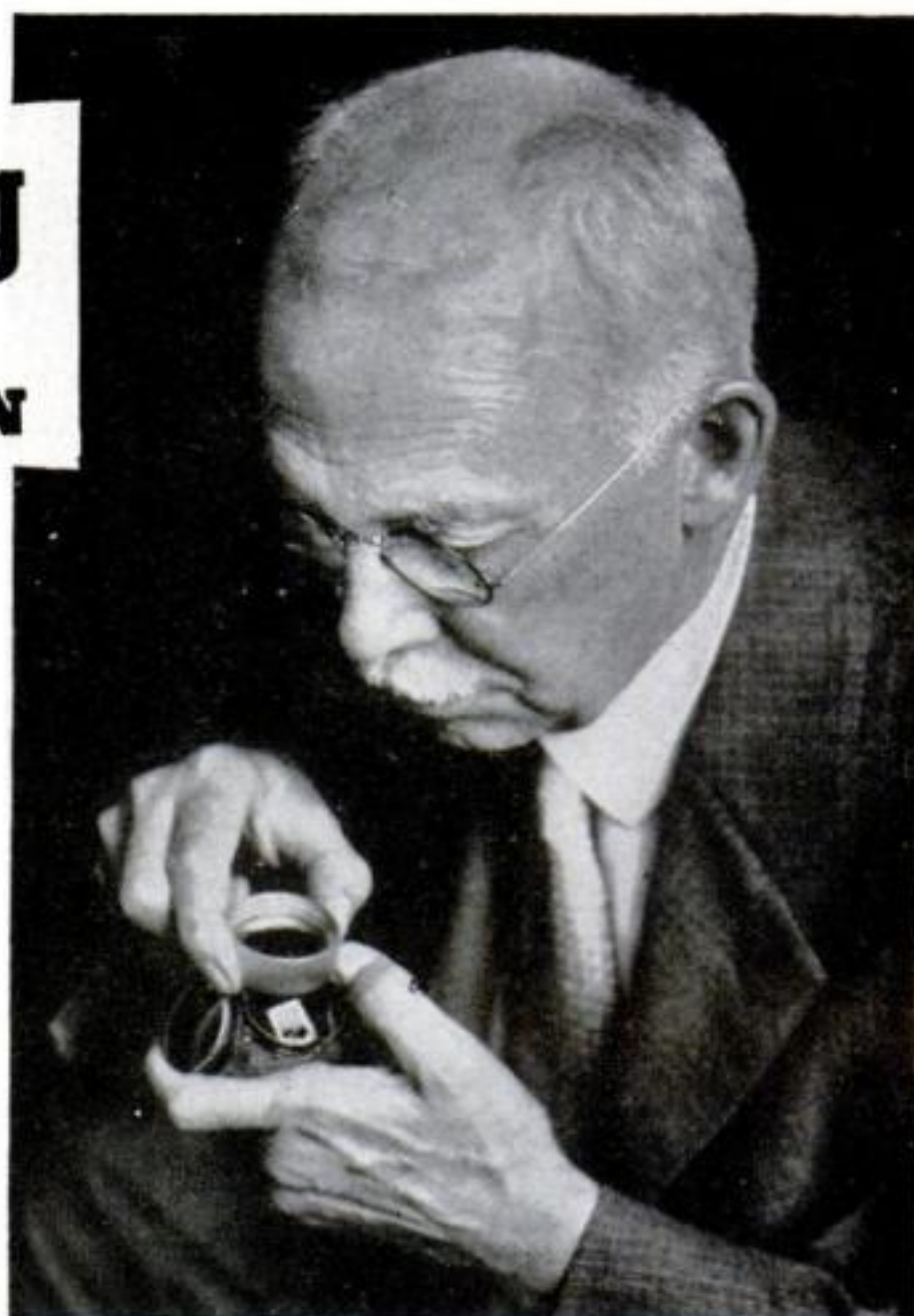
Camera Building

A BUSINESS OF SPLIT-HAIR PRECISION

M ECHANISMS that are almost thinking machines help give American amateur photographers better precision cameras for use in their hobby. At the great Eastman Kodak plants in Rochester, N. Y., recent mechanical innovations check gear teeth to 1/10,000th of an inch; magnify images of tiny parts 100 times for comparison with a master chart in the unending search for microscopic flaws; open and close camera bellows 1,000,000 times in succession to test their strength and endurance.

A new device records the exact amount of sound given off by a running movie camera, and a special electric "climate box" subjects completed cameras to conditions encountered in all parts of the globe. It can reproduce the subzero cold of the Antarctic or the humid heat of a South American jungle at the will of the scientist in charge of the tests. In this climate box the cameras show they can "take it" in the worst weather in the world.

Such precision testing and manufacturing methods have made it possible to adapt the production machinery of these plants to the making of intricate optical equipment for



During polishing, perfection of a lens surface is checked through a test lens of equal but opposite curvature. If they differ 1/100,000 of an inch, circles of color, called "Newton's rings," appear

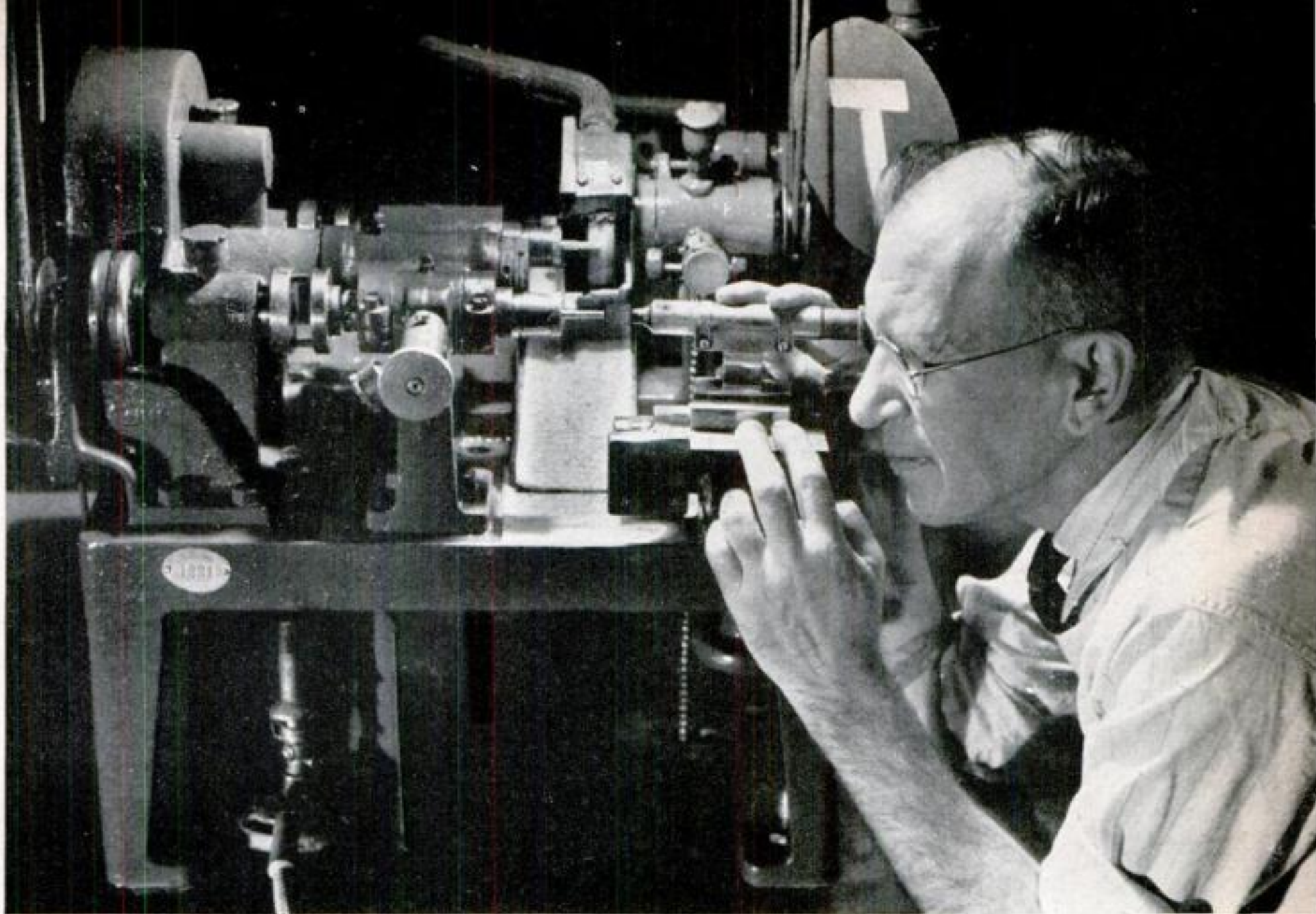
defense. Extremely accurate instruments for directing artillery fire are among the more important products of today's scientific camera-building techniques.



Shining through a camera lens from the end of a tunnel 75' away, a point of light is examined through the microscope. Its size and shape indicate lens quality



Temperature extremes—tropic humidity and arctic cold—are reproduced in a "weather box" to find out how well cameras stand up

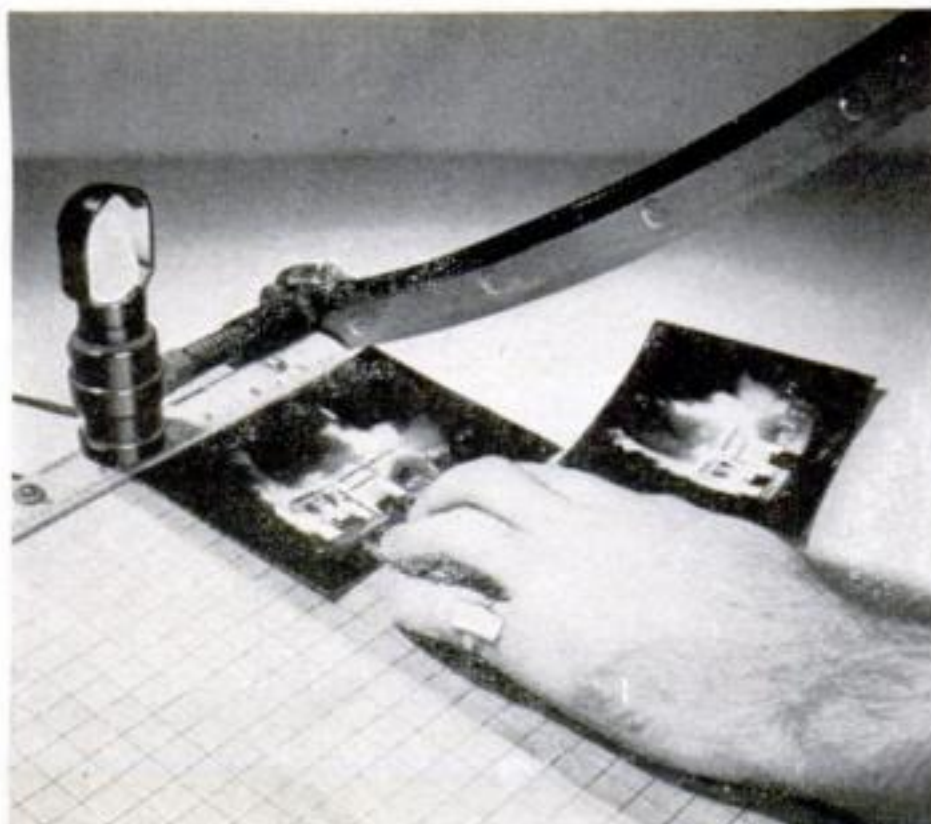


"Centering" a lens before "edge-grinding." It is vital to precision that the optical axis of the lens coincide with its geometrical axis. The lens is spun, while wax attaching it to the spindle is still soft, until a reflected "T" on its surface is immobile. Only then is the edge ground to fit its mount

The bellows of a new camera model is opened and shut 1,000,000 times by the tireless machine below in a "life actuating" test. Even the avid "shutter bug" opens his camera hardly more than 1,000 times a year

Some parts, so tiny that they must be strained through a fine sieve from an oil bath in which they are machined, are magnified 100 times to be compared for accuracy with a master chart





Mounted as above, the lamp aids in trimming prints in the darkroom. At left, lamp on a cleat under the board

Auxiliary Lamp Illuminates Trimming Board in Darkroom

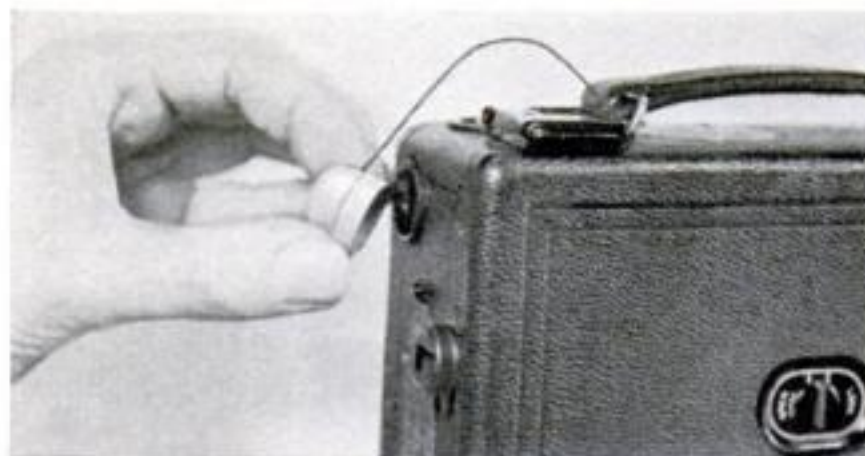
WHERE sensitized paper must be cut at some distance from the darkroom safelight, an auxiliary lamp on the trimming board will prevent errors. Screw a 2" by $\frac{1}{8}$ " bolt through the mounting hole of a small surface receptacle. The projecting end is then pushed into a $\frac{1}{8}$ " hole drilled wherever convenient on the trimming board, as shown in the photograph at the right. A small night light having a built-in switch and plastic shade is plugged into the receptacle and

fitted with a suitable orange or red bulb for cutting sensitized paper. Ordinarily it can be used with a white bulb to aid in trimming prints.

As an alternative, fasten a wooden cleat to the underside of the board with one screw so that it can be pivoted from side to side, and drill a $\frac{1}{8}$ " hole into the end so that the receptacle may be mounted as at the left. In its horizontal position the lamp throws its light upward for identifying negatives.

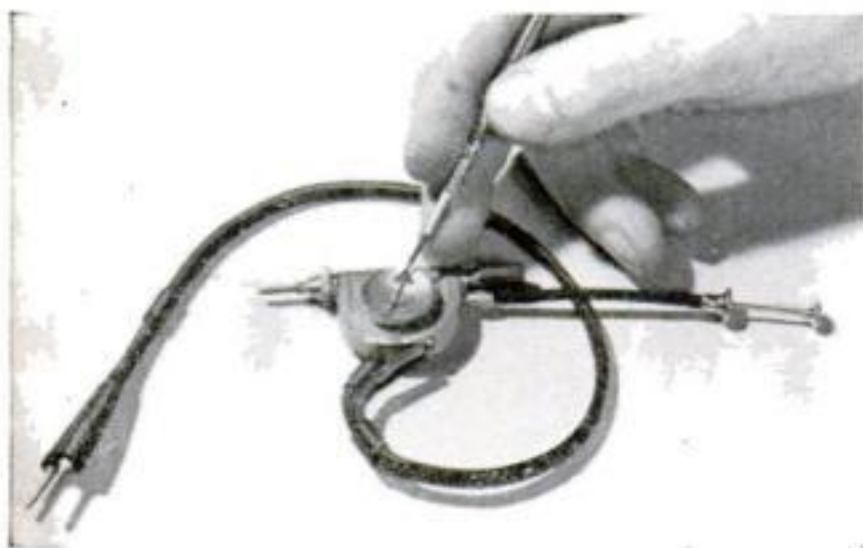
Arrow Reminds Photographer to Set Synchronizer Knob

IN USING a mechanical flash synchronizer of the type shown below, it is easy to forget to set the winding knob, with the result that a picture may be lost and a bulb wasted. Painting a red arrow on the knob so that it points upward when the latter is not set, and toward the subject when it is, provides a simple telltale.



Aid in Preventing Wasted Film

SOMETIMES the lens cap of a motion-picture camera is forgotten and left in place, with the result that film is wasted. As a reminder, fasten the cap to the camera with a piece of fishline in such a way that the line must pass over a folding view finder as above, or in front of a built-in finder, when the cap is on the lens. Incidentally, the soft rubber cap illustrated was made from the bulb of a medicine-dropper bottle, and was turned inside out so as to fit very snugly.—W. B.





Contrasting portraits of the same subject posed in the same light, but with the difference that a pane of glass smeared with petroleum jelly was placed between subject and lens to obtain the soft effect of the one at right. The example is extreme; more often a lesser degree of softness would be desirable

Grease Smeared on Glass Gives Soft, Lovely Portrait Effects

AMATEUR photographers often look with something akin to envy at the ethereal, soft-focus loveliness with which professionals are able to enhance portraits of beautiful women. Of course, the professionals have costly lenses and elaborate studio facilities, including vignettters. Any photographer, nevertheless, can obtain similar effects by using nothing more than a sheet of clear glass smeared with petroleum jelly.

The glass, which should be a good grade, is mounted between the camera and the subject. In the set-up illustrated, one pane of a French door is used for convenience. The petroleum jelly is applied to the glass in the form of an irregular ring so as to leave the center clear. The great advantage of this method is that the photographer can study the effect on the ground glass and smear the oil film around until he has framed the subject's face with precisely the degree of softness for which he is striving. The exposure is then made in the usual way.

After a little practice, the method becomes almost foolproof, but it must be used with discretion. The example illustrated has been taken purposely to show the extreme softness that can be obtained—much more than would be advisable in ordinary portraiture.



Taking the portrait through one pane of a French door. Grease is smeared as a frame, leaving the center clear. The effect can be judged precisely by viewing the image on the camera's ground glass



FIG. 1



FIG. 2



FIG. 3

Fig. 1, paper negative with conventional floodlighting. Fig. 2, silhouette effect by reflected light. Fig. 3, same as Fig. 2, but with a baby spot on the glass and the background shaded. Above, set-up and lighting for Fig. 3

Test Negatives Made on Enlarging Paper Check Lighting Set-Ups before Picture Is Taken

HAVE you ever wished you could see a negative of one indoor shot before taking the next, so that the camera angle, position of the subject, lighting, high lights, and shadows could be checked and the picture finally taken with certainty that it would be as intended? You can make such test shots, and see the results three minutes afterwards, by using enlarging paper instead of film in the camera.

Use a high-speed enlarging paper with a long exposure scale. A glossy paper of the soft grade (No. 1) is best. Exposure can be determined by experiment. Tests with one paper indicated its speed as about 0.3 Weston, or about one fiftieth that of film rated at Weston 16. Exposure is somewhat more critical than that of film.

Cut to size, the paper can be inserted in plate or cut-film holders for several shots in rapid succession or exposed one piece at a time in a discarded film pack. In roll-film cameras it is held in position by the pressure plate, and the camera must be taken to the darkroom and opened before and after each exposure.

Develop fully for maximum contrast in the developer recommended by the manufacturer of the paper. After one minute in the hypo, the negative can be inspected under normal room lighting, but if it is to be kept for reference it should be returned to the hypo for full fixation. The wet sheets are kept flat and are more easily handled if they are squeegeed face down on a sheet of glass.—S. GORDON TAYLOR.

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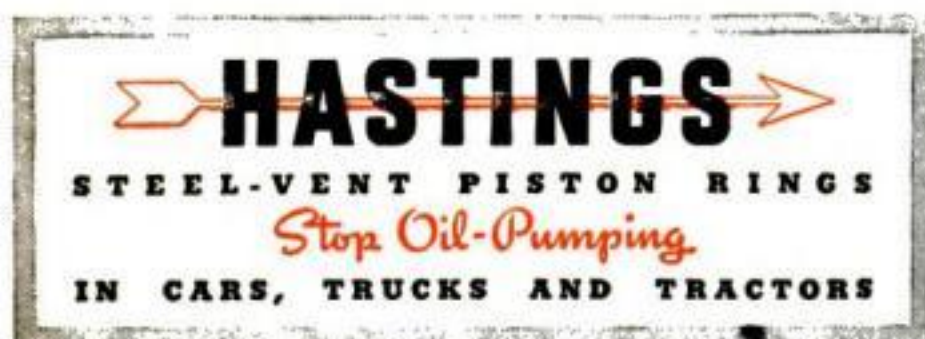
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Gus Pulls Some Wires

(Continued from page 144)

call just as soon as I know the bad news."

Elmer hurried out. For five minutes Gus went over the car's wiring with his instruments. "Too much resistance everywhere," he said finally. "Resistance, Wally, is a thief that robs you of your battery's juice. No wonder Elmer's engine hasn't been running right."

"What makes resistance?" Wally wanted to know.

"Oh, lots of things," Gus told him. "Loose connections, and corroded and frayed cables are among them. Cable that isn't big enough to do its job is a big resistance-maker. Sometimes when cables are replaced the new ones that are put in aren't of as large gauge as the old ones were. Bad insulation causes voltage drop. It lets the juice leak out. If insulation is broken, frayed, hard, brittle, or oil-soaked, the cable or wire should be replaced."

While he had been talking Gus had been looking at and feeling various cables, wires, and connections. Now he shook his head, got out a pad, and began to figure. "There's only one cure for Elmer's trouble," he said. "That's an entire rewiring job."

He went into the office and gave Elmer the bad news over the telephone. When he told him how much the rewiring job would cost there was a lengthy silence at the other end of the wire. Then Elmer's voice said, a little weakly, "O.K.—go ahead."

Late that afternoon Joe Clark came into the shop and found Gus ripping wiring out of Elmer Jones's car. "What the dickens are you doing?" he demanded.

Gus grinned at him. "Oh, just a little wire pulling," he said. "We all have to do it now and then."

Joe grinned back. "Well, wire pulling is a good way to get ahead," he commented.

"Sure it is," Gus agreed. "And when the wiring system on a car is as thoroughly rotted out as it is on this bus, it's the only way to get ahead—or to get anywhere else."

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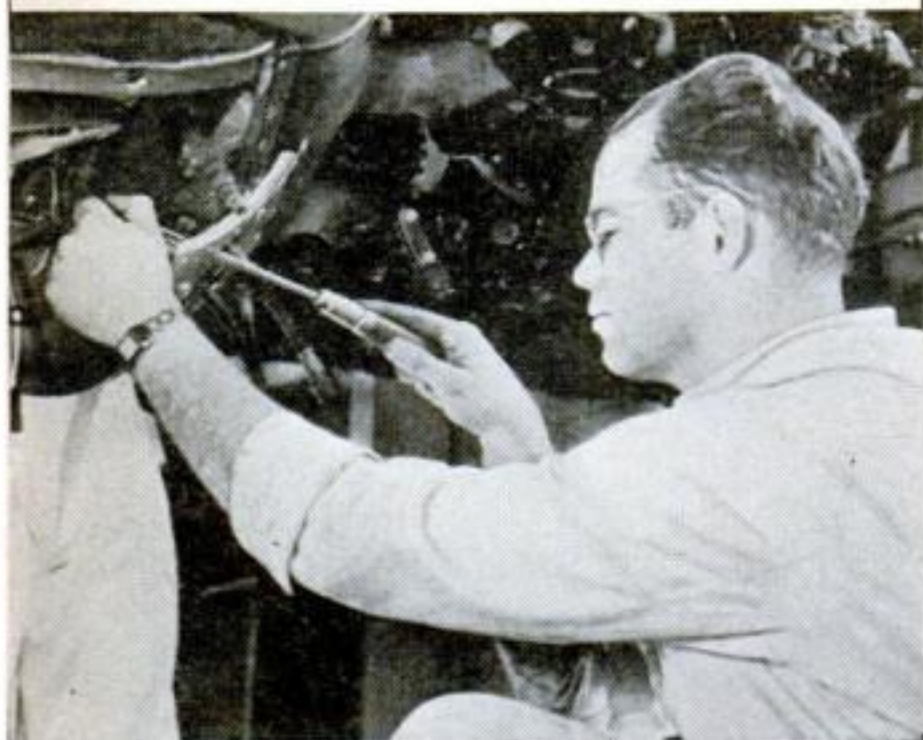
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Before the Bomber —Observation

(Continued from page 89)

up a set of these pictures into glossy prints in 55 minutes after the observer hits the ground, and then the pictures are sped off for one of the most interesting processes in the modern Army.

Interpretation of air photographs is an art which has been developed intensively since the first World War. It involves mainly the understanding of shadows as they appear in the pictures. Different objects cast different types of shadows, and also in the art of camouflage you can't paint a shadow to look plausible at every time of day. By comparing photographs made on successive days, the interpreters often are able to detect signs of important activity which would seem to have been well concealed. A grove of trees may be set up to look most convincing, but if it grew there since last week, it obviously is a phony.

It has been only recently that extensive use has been made of the stereoscopic principle, on which the effectiveness of human vision is based. A man's two eyes see two different pictures from two points of view, and it is through the blending of these two in the brain that we are able to perceive depth and judge distance. The same effect is obtained in photography by taking two pictures from different points of view, and viewing them through a stereoscope.

The 60-percent overlap in aerial photography of course exaggerates the difference in point of view, and exaggerates the stereoscopic effect. The set of three pictures enables the interpreter to look at the same objective stereoscopically from two directions. Looked at through a stereoscope, objects in sight seem to leap from the surface of the ground.

But the Army engineers, who have been instructing large classes of officers in air interpretation at Fort Belvoir, Md., are not content to let their pupils use stereoscopes to help them at the job. These interpreters have to learn so to control their eye muscles that they can look at a different picture with each eye, and make them blend into a stereoscopic image. If you see an Army officer appearing wall-eyed, with a distant look, he probably has been practicing stereoscopic vision. With a little practice, one can become remarkably skillful at this. And in wartime speed is an important factor.

At least that's one thing Howie Olsen won't have to learn. They don't ask observers to cultivate the glassy stare.



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Here's a smoke you'll enjoy!**

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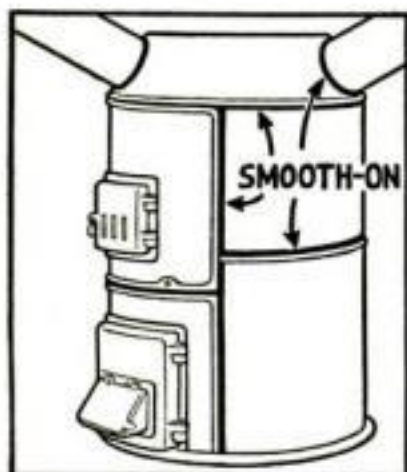
**Ask for FRIENDS...don't forget!
Friends, you'll like it best yet!**

YO HO! AND THE FLAVOR OF RUM!

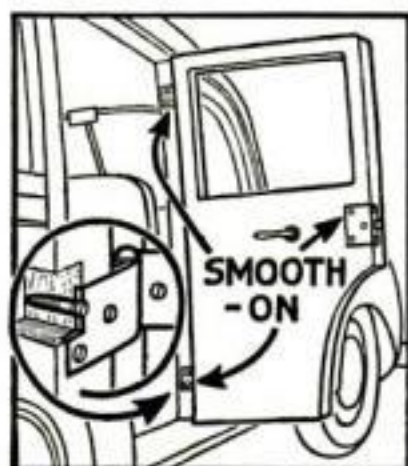


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Home Workshops Go to War

(Continued from page 80)

little space. Although Carell's basement is only 20 feet long and 18 feet wide, on one side of it he has two lathes, two milling machines, a drill press, and a tool cabinet; on the other an air compressor, two power saws, a surfacing machine, a power tool grinder, a metal rack, and a workbench. "There isn't any wasted space," Carell said, "but I like to have my machines close together. If a fellow doesn't have to waste his time walking from one machine to another, sometimes he can operate two of them at the same time." After he had shown me several ingenious attachments—one of them an automatic cooling system to keep metal being worked at the correct temperature—he has devised to save time and labor, I asked him how he liked being his own boss and working 18 hours a day. "I like it fine," he said. "Believe it or not, I'm gaining weight. The only thing that bothers me is that I don't have time to play with the kids' railroad. What does my wife think about it? She's with me 100 percent—she's glad I'm doing what I always wanted to do, and she's just as glad that I'm able to do a little something to beat those damn Japs and Nazis."

Our next stop was at John Lindstrom's. He has done a lot of expanding since the day he told Carlson that he had decided to start out for himself. To accommodate old machine tools he has bought and reconditioned, he has had to enlarge his garage twice, and he is planning another addition. He has eight men working for him on day and night shifts—men who aren't professional machinists, but whom he has trained to do precision work. He gets many of the most difficult and most profitable company subcontracts.

One of the reasons for his success is that he is a wonder at figuring out ways of saving time on difficult machining operations. One of his contracts was for parts essential to a gun recoil mechanism—I am not permitted to be more specific. These parts came to him in the form of soft steel castings faced with colomonoy, an alloy so hard that a diamond won't scratch it. His part of the job was to grind them down to the exact specified shape and size—an operation which takes 4 1/2 hours for each individual part. Lindstrom devised a lathe fixture which makes it possible to grind four of them in the same time that it took to grind one.

While we were talking he opened an old-
(Continued on page 224)

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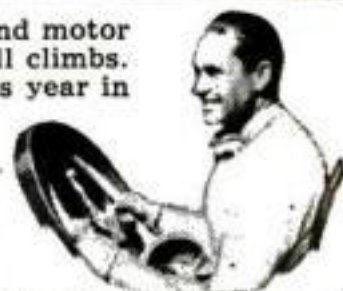
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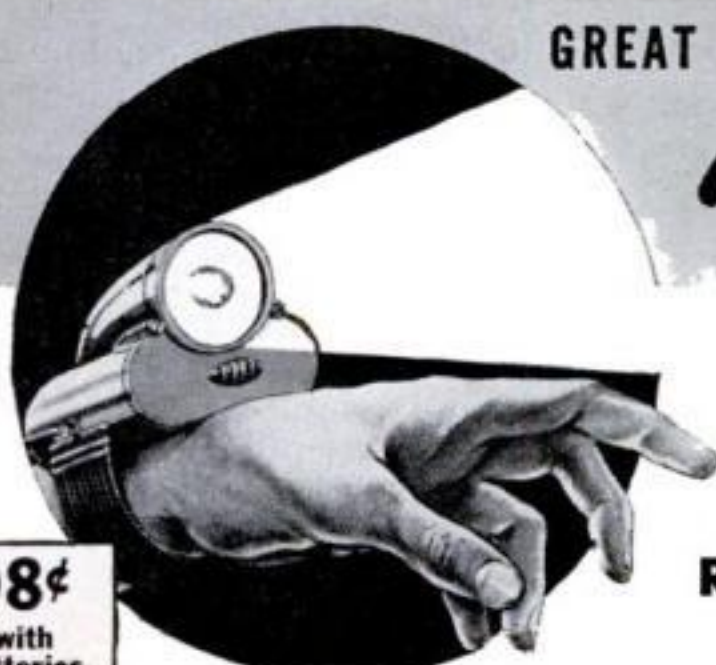
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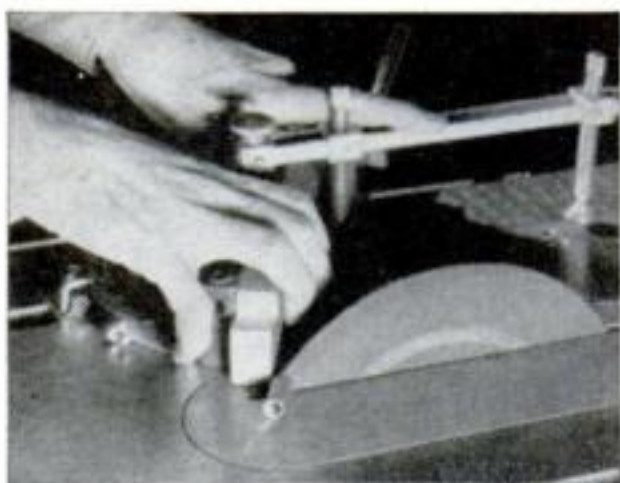
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Home Workshops Go to War

(Continued from page 222)

fashioned roll-top desk, and I noticed a good color print of Abraham Lincoln under its heavy glass writing surface. Lindstrom saw me glancing at it, and looked embarrassed. "Maybe you think it's funny, a Swede having that picture," he said after a moment. "Lincoln is my hero because he started from nowhere and got somewhere, and because he was a great American. I started from nowhere, too, and maybe I'll get somewhere—my kids will have a chance to, anyhow. I'm a good American, too—even if I wasn't born here. I've been in America 16 years, and before I settled in New Jersey I had jobs all the way from Chicago out to Spokane and back. Everything goes right for me since I came to this country. Now I've got my own little business, but it isn't only because that is a dream that has come true that I feel happy. It is because now I can do something to help the United States. I will do everything I can. My wife was born in Norway. She feels just like I do about it."

George C. Wyland is another one of the company's top-flight subcontractors. For many years he built and maintained scientific apparatus for the School of Mines of Columbia University. A hobbyist with a well-equipped machine shop in the basement of his home, he answered the advertisement in the newspaper, and after a few weeks of spare-time work resigned his college position to give all his time to subcontracting. He now has six men working for him.

One of the most successful of the spare-time subcontractors is a schoolteacher who spends a steady 40 hours a week at a lathe in his basement shop. Michael Brodsky, a toolmaker in a rubber plant, used to make model gasoline engines in his home shop. Now, in addition to 53 hours a week on his regular job, he works 50 hours a week at home. His subcontracting is a family affair—his brother-in-law averages between 40 and 50 hours a week, and both Mrs. Brodsky and her sister have learned to rough out small parts on an old lathe. Carl Riel, who is a foreman in a food-products plant, works 25 hours a week on airplane tools and ship-fitting parts, his wife knitting busily for the Marines while she keeps him company in his basement shop.

All these people are working hard and going short on sleep—but they like it. They like it because the work is highly profitable, and they like it even more because they know that they are helping to win the war.

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That's why Harley-Davidsons have been chosen for action in the nation's hard-hitting motorized divisions. The fellows who ride 'em are getting real action as they handle toughest assignments with Harley-Davidson's power, stamina and rugged dependability to bring them through to victory! See your Harley-Davidson dealer — and learn all about the superior performance of these world champion motorcycles — also look over his special values in reconditioned models.

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Seaworthy Outboard Boat Built with Hand Tools

PAUL H. KOOPMAN, of Fulda, Minn., might claim some sort of record for building the trim 11' 6" long fisherman's outboard boat shown above, for he had only a few old, well-worn hand tools to work with. The boat planes, he writes, with a 9-h.p. engine and a 400-lb. load aboard, yet it is amazingly steady in choppy water.

Hundreds of amateurs are building boats today—shipshape craft that pay big dividends of fun and satisfaction to their owners. POPULAR SCIENCE blueprints will help you to get in the swim of this popular sport and hobby quickly. Blueprints Nos. 344-345-R for the boat illustrated above are only 75 cents. The price for blueprints together with full-size patterns, which are drawn to order within two weeks, is \$2.25.

A stamped, self-addressed envelope will bring you an illustrated folder describing all our boats. If interested in other projects, send a stamped, self-addressed envelope for our blueprint list.



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Colonial Writing Desk, 3' 6" high and 3' 8" long, 21.....	\$.25
Combination Bench and Tilt-Top Table, (no turning), 11.....	.25
Double-Decker Bed, 277A.....	.25
Drafting Table, 189A.....	.25
Early American Round-Top Stand, 191A.....	.50
Fireplace Screen (brass and wrought iron), Bed-side Cabinet, and Trinket Box, 389A.....	.25
Hanging Wall Cabinet, 9½" by 24" by 41¾", 280A.....	.25
Maple Tavern or Long Table, Colonial, 30" by 68" top, 318A.....	.50
Mirror Frame, 20" by 30", 246A.....	.25
Modernistic Folding Screens, 4 designs that require no turning, 91.....	.25
Queen Anne Dressing Table, Stool, and Mirror, 295A.....	.75
Sewing Cabinet of 1812, 178A.....	.50
Tavern Table and Scroll Mirror, 105.....	.25

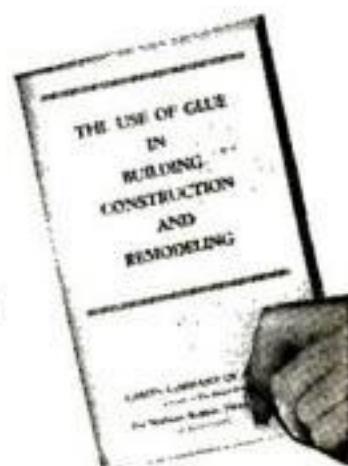
(Continued on page 228)

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Buy Defense Stamps! Conserve Materials! Prevent Waste!

You can add years of usefulness to home and household by keeping things in repair. Not only the everyday household repairs but also the major maintenance of the home. And many of these jobs you can do yourself with simple hand tools and the right Casco Glue.

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Plans for the Workshop

(Continued from page 227)



MODELS

BLUENOSE, famous fishing schooner, 17½" hull, 110-111-112-R.....	1.00
Clipper Ship GREAT REPUBLIC, 31½" hull, 272-273-274-R.....	1.25
Clipper Ship SEA WITCH, 9½" hull, 219.....	.25
Fishing Schooner WE'RE HERE of "Captains Courageous," 9½" over all, 351-R.....	.50
Liner QUEEN MARY, 10¼" hull, 283.....	.25
Miniature Fleet of Nine Modern U. S. Fighting Ships (full-size plans and instructions in booklet form), 372-R.....	.50



BOATS

Cabin Cruiser, 17' long, weighs 750 lb., may be used with 2 to 10 h.p. outboard or inboard motors, 356-357-358-359-R.....	1.50
Camper's Utility Boat, 11' 2" long, canvas-covered, for outboard motor or rowing, 281-R.....	.50
Canoe, 16' canvas-covered kayak; can be used with sail, 192-193-194-R.....	1.00
Combination Boat, 15' hull, for use with sail, outboard motor, or oars, 131-132-133-R.....	1.00
Cruising Sailboat, 19' long, weighs 700 lb., Marconi sloop rig; can be used with 1 to 4 h.p. inboard or outboard motor, 400-401-402-403-404-R.....	2.00
Family Runabout, 13' 6" long, weighs 275 lb., for outboards from 1 to 60 h.p., or oars, 378-379-380-R.....	1.50
High-Speed Boat for Small Outboard Motors, 7' 11" long, 257-R.....	.50
Motorboat-Rowboat, 13' long, with decked hull, for use with outboard or inboard drives, 147-R.....	.50
Plywood Dinghy, 9' 7" long, weighs 60 to 75 lb.; can be rowed, sailed, or used with small outboard motor, 387-388-R.....	.75
Racing Runabout, 13' stepless hydroplane for outboard motor, 261-262-R.....	.75
Racing Sailboat BLACKCAT, 13' 4" long, weighs 250 lb., Marconi rigged, 321-322-323-R.....	1.00
Sectional Rowboat, 9' 8" long; can be used with small outboard, 340-341-R.....	.75
Sport Runabout, 9' 8" long, for small outboard motor weighs 100 lb., 309-310-R.....	.75
Utility Rowboat, 13' long; can also be sailed or driven by outboard motor, 224-R.....	.50



MISCELLANEOUS

Bird and Animal Patterns, 56.....	.25
Bronze Hammer, Rolled-Edge Metal Tray, Table Centerpiece for Easter (rabbit hitched to wagon), 407A.....	.25
Five-Piece Desk Ensemble (letter rack, blotter, letter opener, etc.), Nautical Lamp (resembles engine-room telegraph), 410A.....	.25
Folding Wall Brackets (turned), Treble-Clef Bud Vase (metal or plastic), Vacuum Cleaner Attachment Rack, 408A.....	.25
Outdoorsman's Lightweight Trailer, 10' long, 4' wide, 4' 9" high, kitchenette on back, 300-301-R.....	.75
Turned Costume Jewelry and Solid Model of Argonaut Pirate Flying Boat, 275A.....	.25
Turned Table Lamp, Deringer Pistol, and Weather Vane (woman watering garden), 406A.....	.25
Workbench for Home Shop, 24" by 58" by 34¼" high, 405.....	.25

Popular Science Monthly

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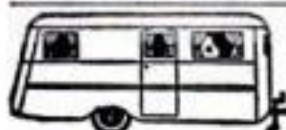


New Guild PORTABLE ELECTRIC Sander

Now, do better sanding this easy way—10 times faster! This sturdy, portable belt sander turns out expert work in minutes—instead of hours of hand-sanding drudgery.

Give everything you make that expert finish. Works on wood, metal, stone, plastics. Sells at popular price—weighs only 9 pounds. Fully guaranteed. Try it at your hardware dealer's, or WRITE us today for full details.

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Complete Plans and
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Wood workers:

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CIRCULAR SAW \$3.50



Outside U. S.
or C.O.D. \$3.75

"The Ripmaker" saves hours of tedious hand sawing. Has 4" combination rip and crosscut blade, oilless bearings and 8" x 5 3/4" steel table adjustable so that pieces up to 1" thick may be cut (pieces up to 2" by turning stock). Base, saw support and table adjusting slide, heavy iron castings. Adjustable ripping fence. A J & H Metal Product. Free Catalog illustrates complete power tool line: Jig Saw, \$1.75; Jointer, \$7.25; Shaper with oilless bearings, \$3.25; Drill Press, \$2.75; completely equipped Lathes, \$2.25 and \$5.40; Sander, \$1.10 etc. Sold direct only. Order today or send card for Catalog.

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New 1942 Radios—50 new models, plastic and wood table models, consoles, FM combinations, phono-radios, phono players, recorders, auto sets, farm radios, etc. Before you buy, see this great Knight line!

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How *Atlas* SERVES THE NATION

One in a series of messages showing how Atlas helps in the Victory Program.

Photo by Arnold, Floyd Bennett Field

BAUSCH & LOMB

Precision

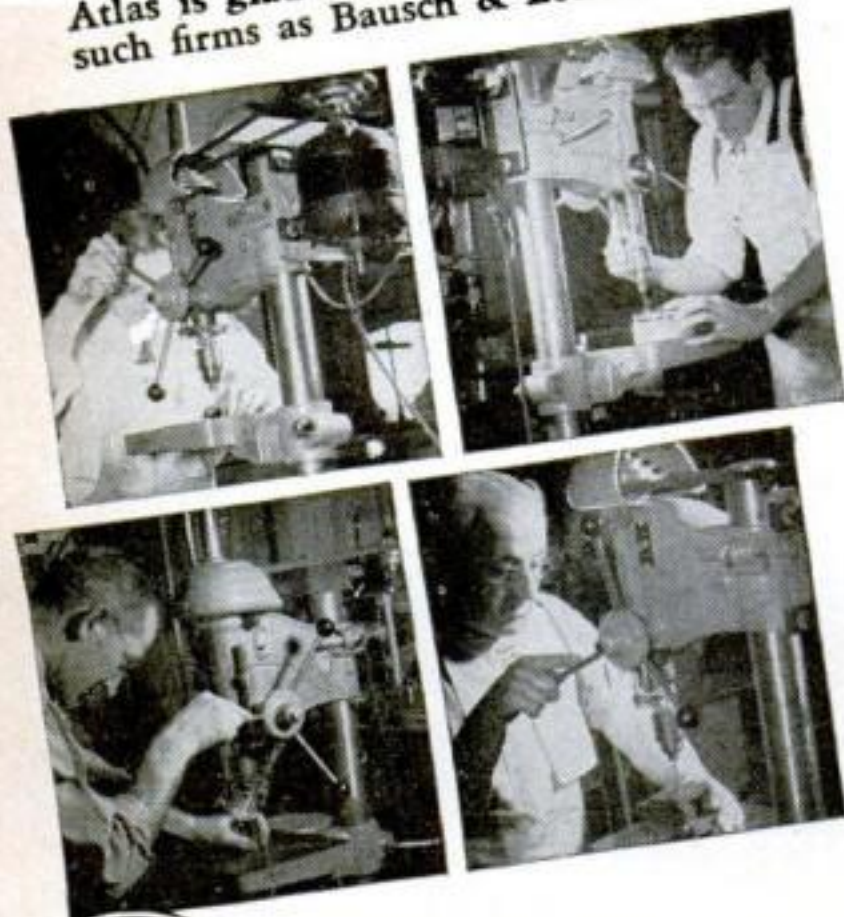
SHARPENS THE

Off. U. S. Navy Photo

"EYES FOR VICTORY"

Before the mighty guns of the Army and Navy thunder into action, powerful "eyes"—telescopes, binoculars, and marvelous range finders—must spot the target. We can all be thankful that the skill of veteran instrument makers of the Bausch & Lomb Optical Company is enlisted for the duration.

Pictured below are some of the Atlas No. 73 Drill Presses on war production in the Bausch & Lomb plant. The operators are typical of those who since 1853 have carried on the B & L precision tradition. Atlas is glad to serve the nation through such firms as Bausch & Lomb.



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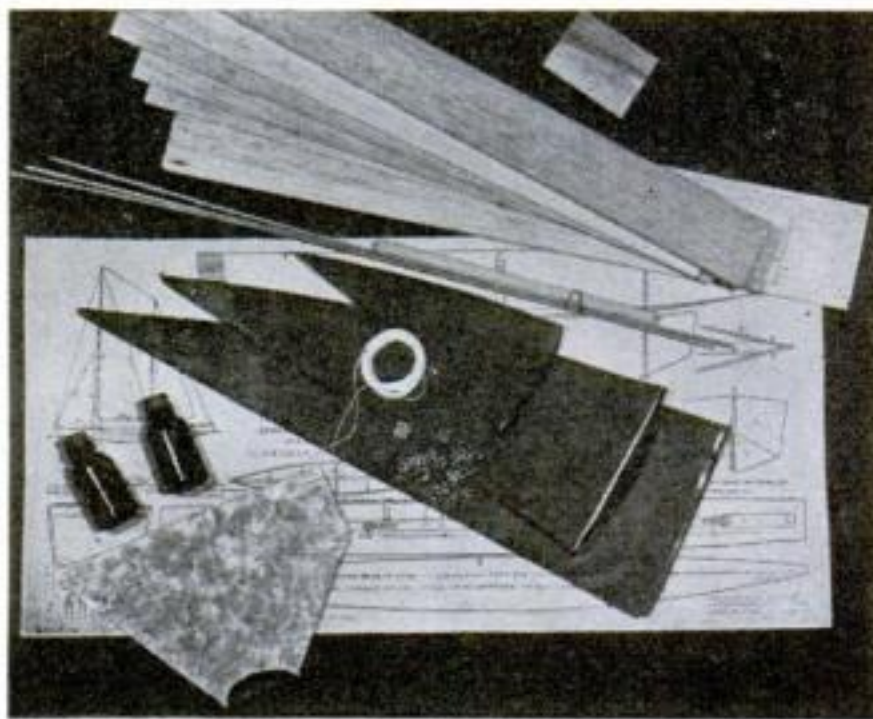


Low-Price Kit Builds Model Prize-Winning Racing Ketch

REAL sailing thrills are yours with this fast model ketch, which can be built from the new construction kit pictured below. The original won the gold medal in Class I at Central Park, New York, in 1940.

The model is 18" long overall, has a beam of 2 7/8" and a draft of 6". The planked balsa hull is as easy to build as a simple model airplane. It is waterproofed with marine glue supplied with the kit, which includes also a lead-weighted keel, waterproof cellulose-film sails, all necessary dowels and balsa, wire fittings, rigging material, and cement. The price of the kit is only one dollar, plus 25 cents for handling and postage.

For a complete list of our many construction kits, which include full-rigged display ship models, modern warships, and miniature Colonial rooms and furniture, send a large stamped, self-addressed envelope.



Revolutionary New Roll Film Yields Full-Color Prints

COLOR photography has arrived at last for the ordinary snapshotter. A revolutionary new type of roll film, now ready for general distribution, enables color negatives to be made in almost any camera of the six most popular sizes used by amateurs. These negatives yield full-color prints on paper in any quantity desired for mounting in an album or for any other uses to which black-and-white prints are put.

The new film, called Kodacolor, comes in six standard sizes: 120 and 620 ($2\frac{1}{4}$ " by $3\frac{1}{4}$ "); 116 and 616 ($2\frac{1}{2}$ " by $4\frac{1}{4}$ "); 122 ($3\frac{1}{4}$ " by $5\frac{1}{2}$ "), and 127 ($1\frac{5}{8}$ " by $2\frac{1}{2}$ "). It is used exactly like other film. The emulsion speed is about Weston 20, as compared with a rating of 24 for Panatomic X and 50 for Verichrome. Exposures of $1/50$ second at apertures of $f/8$ to $f/11$ in bright sunlight are adequate for excellent negatives. Action shots are possible with faster lenses. The emulsion is balanced only for daylight use.

After being exposed, the film is returned to the manufacturer for processing. The price schedule at present ranges from \$1.25 to \$2.40 a roll, including development, and prints are 40 cents apiece. All prints have a uniform width of $2\frac{7}{8}$ " and a length proportionate to the size of the film. Black-and-white prints also can be made from the negatives.

Unlike earlier color films, Kodacolor yields true negatives, in which light areas appear dark and dark ones light. The colors also are reversed, or complementary to the actual subject, red appearing as blue-green, blue as yellow, and so forth. When these negatives are printed on paper coated with a similar emulsion, they produce true-to-life photographs in natural color.

The new film is made possible by a process in which the chemical agents that bring together the blue, red, and green emulsions in the proper proportions—technically called "couplers"—are dissolved in microscopic particles of organic materials suspended in the emulsions. These particles prevent any interaction between the couplers and the silver bromide until the film is placed in the developer. The latter penetrates the particles and reacts with the coupler in each of the three emulsions to form the dye. After the silver has been dissolved out, a dye image remains.

It is not known just when the film will be produced in sufficient quantity to meet the demand that is certain to arise, once amateur photographers realize the extraordinary nature of this new development.



FIX IT— THIS QUICK, EASY WAY!

● Next time any metalware around your house develops punctures—holes, cracks, messy leaks—conserve that precious metal by mending it with solder. But be sure to use the household solder that's pure, safe, quick, easy to use . . . Kester Metal Mender, the kind people have been using for 42 years. Why, for only a quarter you can solder every pot and pan in the house! Fix pumps and auto parts and lamps and screens and doorknobs and downspouts! Think of the saving! *Especially now, when metal is vitally needed for armament!*

● Don't think you can't solder. With Kester Metal Mender it's as easy as writing your name. Just apply heat to the metal to be mended, then a touch of Kester Metal Mender, the original flux-filled wire solder. No unsightly and unsafe acid pots to complicate the job, for the flux is *inside* the solder in just the right amount. That's why you don't need skill to do an expert job of mending metal!

● Find out for yourself—**FREE**—how easy it is to solder. Send coupon for generous trial sample of Kester Metal Mender and for "How To Use It" Book. Start now to save metal for Uncle Sam, and save money for yourself, with Kester Metal Mender.



KESTER

METAL MENDER

You Can Paste this Coupon on a Post Card

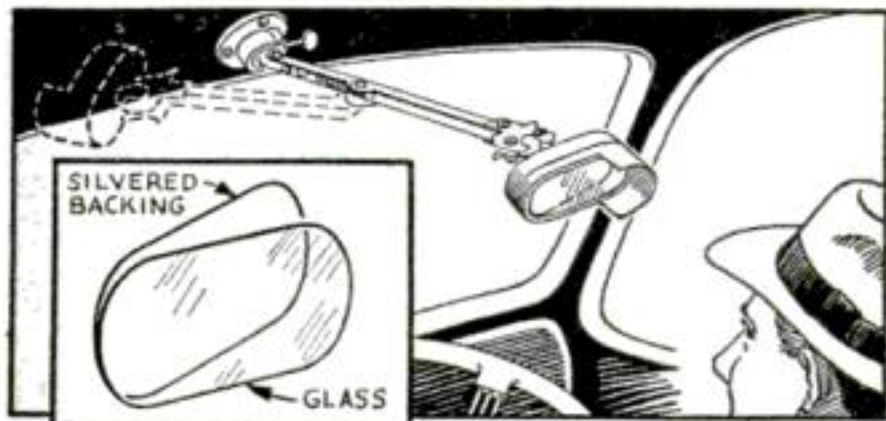
Kester Solder Company
4253-3 Wrightwood Avenue, Chicago, Ill.
Please send me free sample of Kester Metal Mender and "How-to-Use-It" Booklet.

Name _____
Address _____
City _____ State _____

Mail the Coupon Now

With the Inventors

REAR-VIEW MIRRORS that kill the glare of headlights behind, in night driving, have taken a number of ingenious forms. In a new way, Walter Bransted of Rivervale, N. J., applies the method of combining a glass face and a



silvered backing at a slight angle to one another. In the daytime, the motorist sees the bright reflection from the silvered part. At night he need only shift his head a trifle sideward to cut out this reflection. The headlights of a following car then appear as "ghost" images, plainly visible but comfortably dimmed, by reflection from the glass face. In previous mirrors of the kind, the change has had to be made by hand adjustment. The present invention makes this unnecessary by mounting the mirror on an extension bracket a short distance in front of the driver's eyes, thus magnifying the effect produced by a slight change in the angle of view. A hinge in the bracket permits the mirror to be folded out of the way, whenever desired, to the position shown by dotted lines in the illustration.

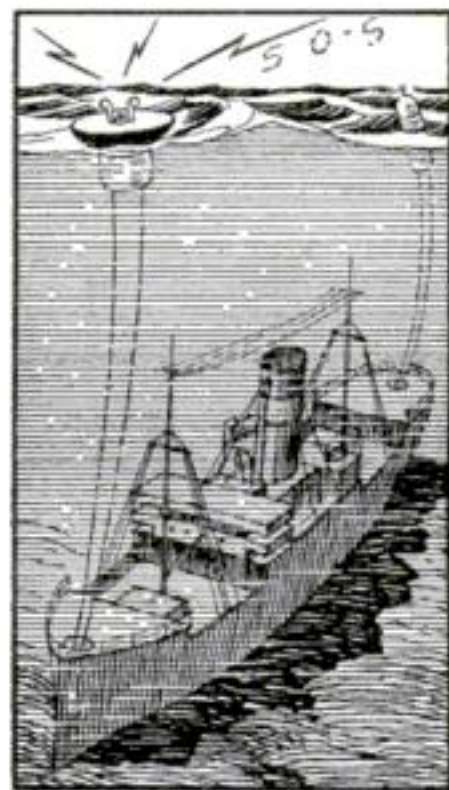


he provides a "brake" in the form of a series of circular grooves and lands, of progressively larger size. The result is a retarding effect, enabling the user to control the depth

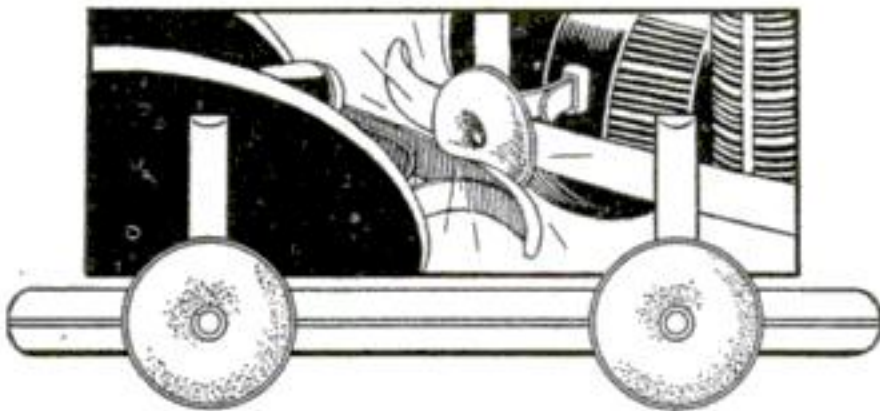
... FOR MAKING HOLES of any desired size in cans of milk, fruit juices, and beer, a handy punch has been designed by William A. Coone of Elgin, Ill. Because of the force with which such a tool is applied, he declares, a smooth conical point is difficult to stop before it has driven an oversize hole. Therefore

and size of the puncture. The accompanying illustration shows the tool in use, and three sizes of holes made by the indicated extent of penetration. In a modified form of the invention, the grooves and lands are replaced by a milled surface, which serves a similar purpose.

... AUTOMATIC RADIO AND MARKER BUOYS, proposed by T. H. Donnerstog of St. Paul, Minn., are designed to aid in the rescue of personnel and the possible salvage of a sunken vessel. At the forward end, a ship would carry a large steel buoy which would rise



to the surface at the end of cable moorings, and transmit SOS signals from a built-in, self-operating radio set. Lifeboats could cluster about the buoy, or crew members could use it as a raft, until help came. A smaller buoy would serve as a marker for the stern of the ship. In salvage operations, the mooring cables of the buoys could be replaced by stronger ones to aid in raising the ship. ... TO CUSHION THE IMPACT of colliding auto bumpers, a type equipped with a pair of resilient buffers has been worked out by Rollie B. Fageol of Beverly Hills, Calif. Passing through the center of each doughnut-shaped buffer, a bolt fastens it and a shock-absorbing mounting block to the main part of the bumper. A recess



in the buffer permits the bolt to be sunk well behind the cushioning face. Danger of injury to passengers, who may be pitched forward or backward in even a minor col-

(Continued on page 235)

NOW a DYNAMIC HEAVY DUTY INDUSTRIAL WELDER

THE BOOM IS ON IN WELDING—EARNINGS ARE SKYROCKETING

**WORKS OFF
110 VOLT
ELECTRIC
LIGHT
CIRCUIT**



Thousands of welders have already left their jobs and shops to get "war-time" pay in plants devoted to defense production, such as ship building, tanks, airplanes, munitions, etc. Also, in the erection of industrial plants, bridge construction work, etc. This creates an unusual opportunity for men everywhere to get in the welding business right in their own communities, and take over the work these men have left behind. No special training is required, for now with the new DYNAMIC Super-Charged Transformer-Type Welder that works off a 110 volt electric light circuit, men without previous experience, by following the simple, concise home instructions can quickly do finished repair jobs. In this way you may fit yourself to qualify for a big pay job in the defense industry.

WELDS BUMPERS, FENDERS, CYLINDER BLOCKS, BODIES, FRAMES, ETC. Does Farm, Factory and Home Repairs

Many welders make as much as \$15 to \$20 a day. Repair jobs that can be done in less than an hour can make as much as \$5.00. Any number of jobs can be done more efficiently with welding. The DYNAMIC Super-Charged Welder, despite its serviceability, is so easily portable it can be carried around by hand and taken right to the job. This is an added feature whose value you will appreciate once you are in welding.

**WORKS ON IRON
STEEL, TIN, BRASS, COPPER,
AND ALL OTHER METALS**

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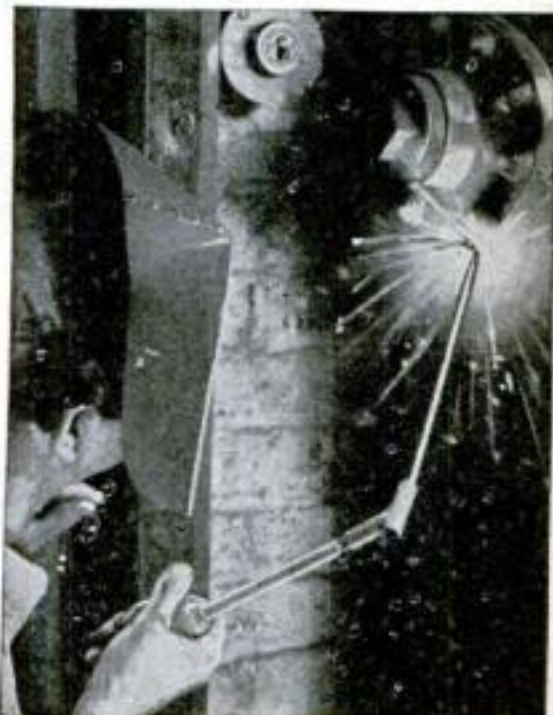
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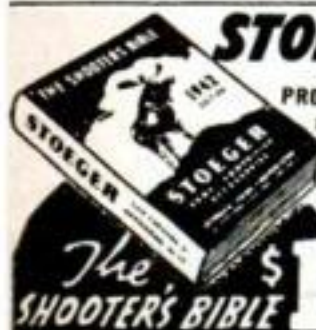
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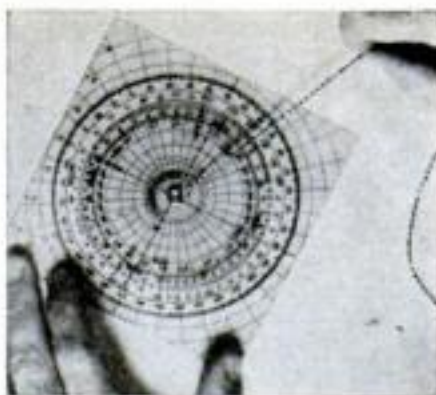


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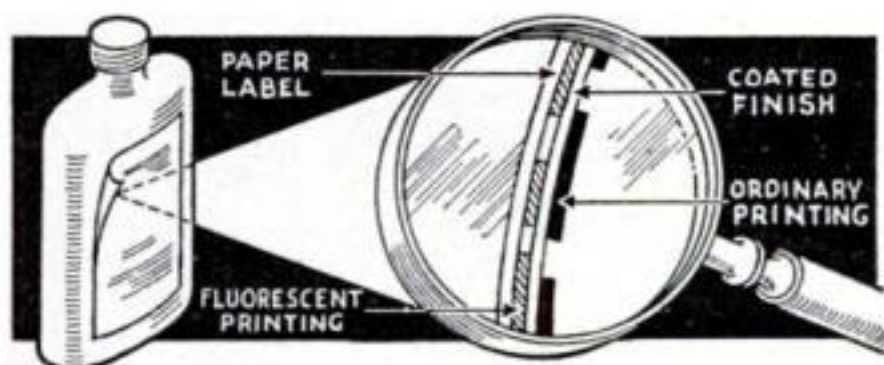
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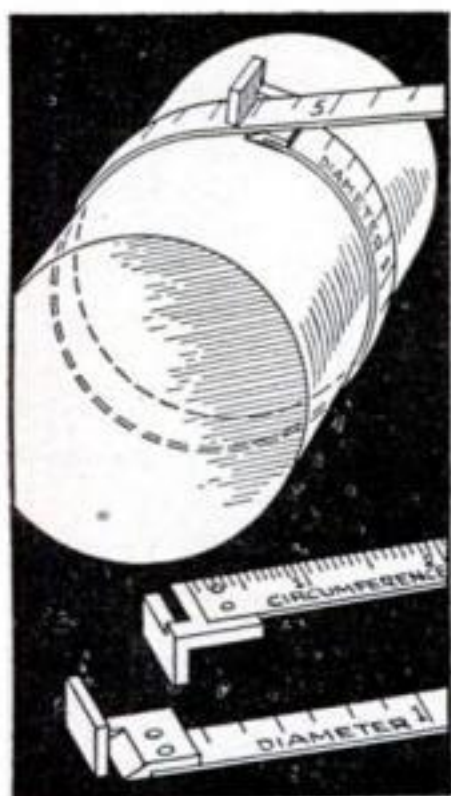
(Continued from page 232)

lision, is declared to be minimized by the additional protection. In addition, the inventor maintains, the buffers offer a safeguard against marred, bent, or broken bumpers, and are not themselves easily damaged. . . .



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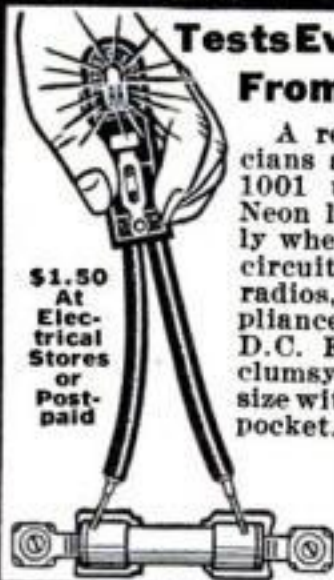
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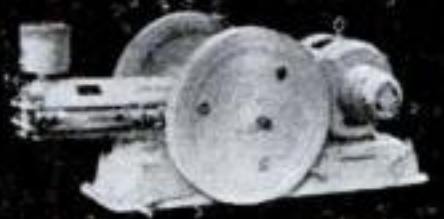
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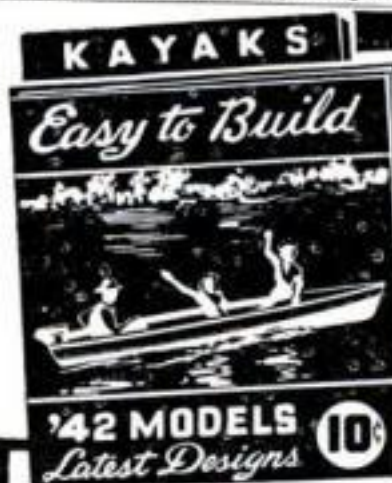
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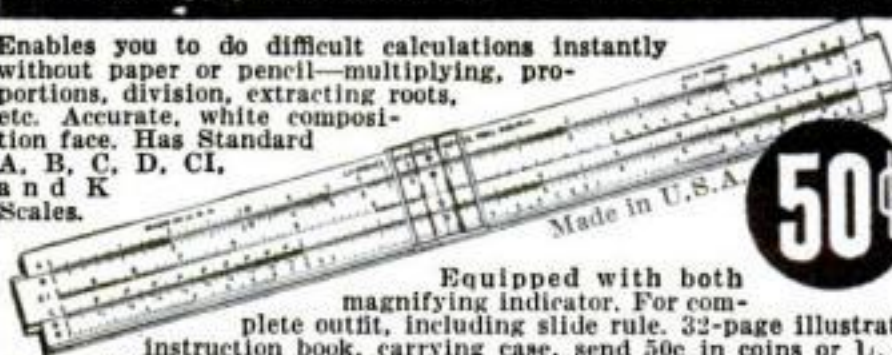
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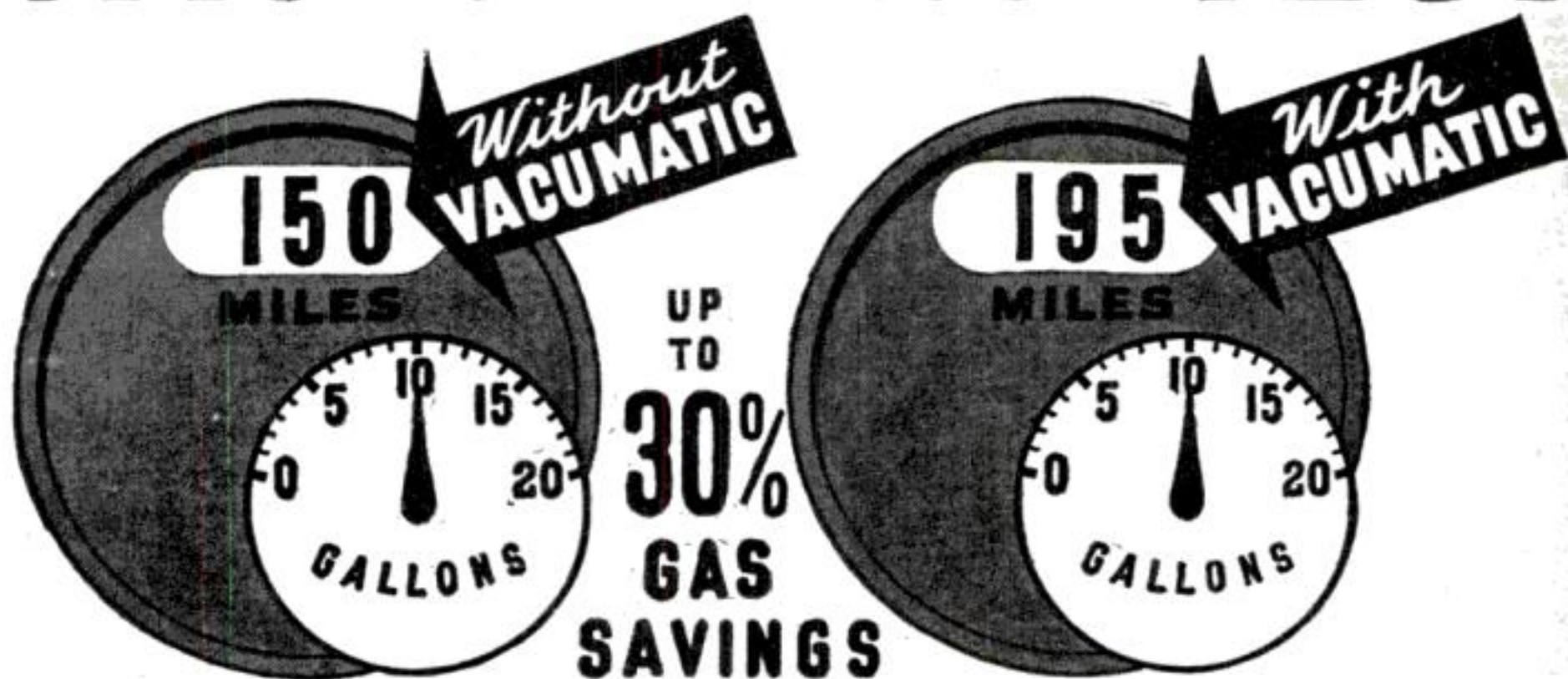
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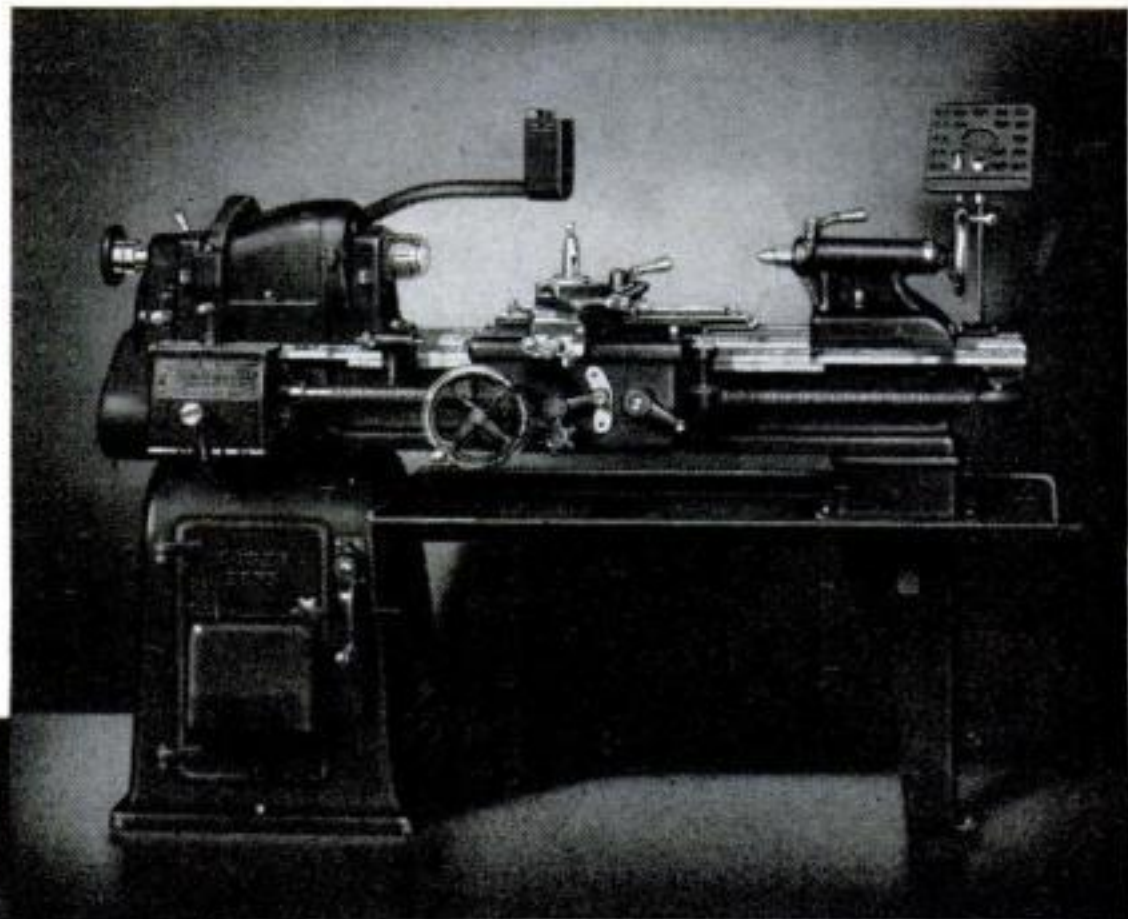
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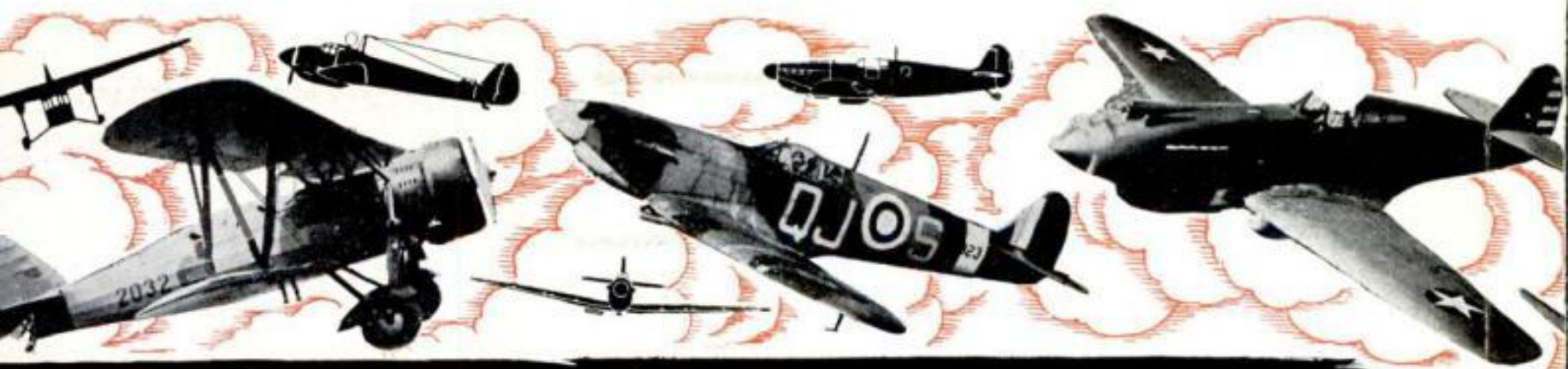
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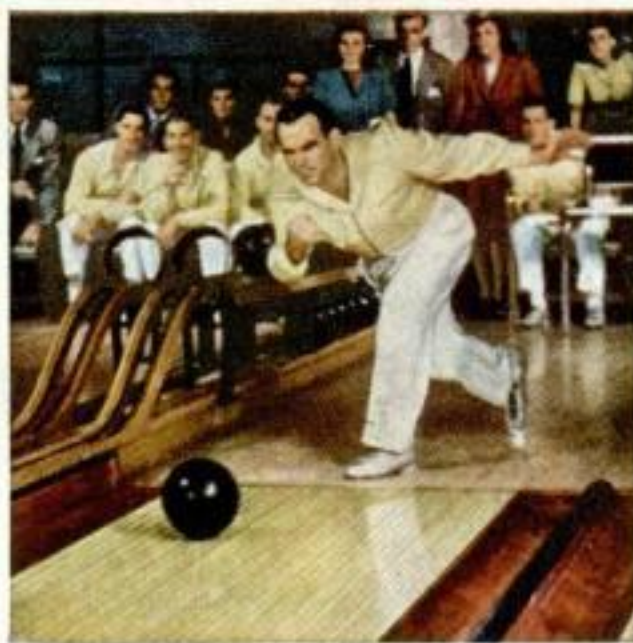


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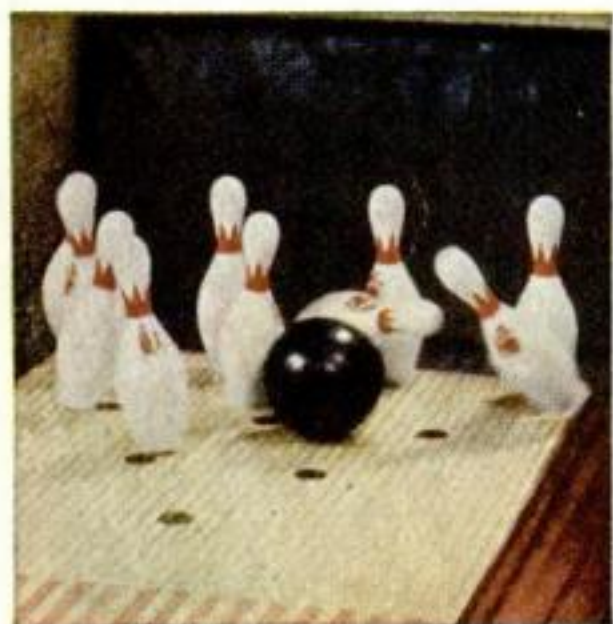
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AND SET UP THE CAMELS, TOO
Whether you're bowling
yourself—or just watching
—nothing hits the spot like
a cool, flavorful Camel

TALK ABOUT your wood-gettin' wonder! You're looking right at him—"Low" Jackson of St. Louis, 1941 All-American, captain of the world's match game champions. Light up a slower-burning Camel and watch this champion of champions in action.

THERE'S A SWIFT FLASH of the arm. The ball whirls down the alley. Take a good look at the way "Low" Jackson tossed that one—that's an All-American hook. Close to the gutter. Three-quarters down, she starts to break—straight for the slot. Watch it now—it's—



IT'S
STRICTLY CAMELS
WITH ME.
EXTRA MILD
WITH A **FLAVOR**
THAT ALWAYS
HITS THE SPOT

A PERFECT HIT! Like a homer with the bases loaded . . . like the full, rich flavor of a certain cigarette, it never fails to thrill. No matter how much you smoke, there's always a fresh, welcome taste to a Camel—for Camels are milder with less nicotine in the smoke.

THE SCORE-BOARD tells the story. More smokers prefer Camels . . . smokers like Lowell Jackson to whom mildness is so important . . . smokers who want a flavor that doesn't tire the taste. You'll never know what you've been missing until you smoke Camels.

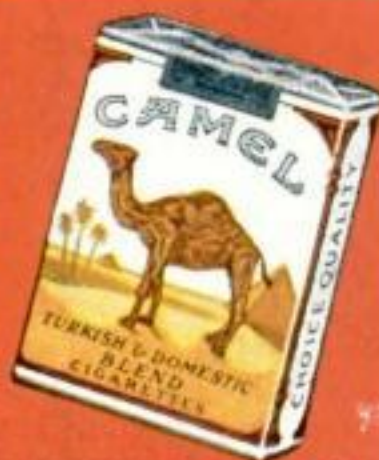
TWENTY TIMES "Low" Jackson (*above*) has rolled the perfect score. Every time he lights up a Camel he smokes with the assurance of modern laboratory science that in the smoke of milder, slower-burning Camels there is less nicotine (*see below, left*). Get Camels next time.

The *smoke* of slower-burning
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28% LESS NICOTINE

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slower than the
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